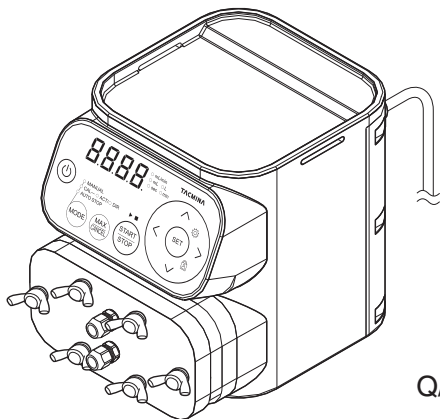


Smoothflow Pump

Q Series

OPERATION MANUAL

Please read this OPERATION MANUAL carefully before use.
Operating the pump incorrectly in disregard of these instructions
may lead to death, injury and/or cause property damage.



In order to use this pump
with the correct flow rate,
calibrate the pump.



Page **29**

Applicable Model

Q/QI/QT-10/30/60/100/500-ULP

- TACMINA accepts no liability whatsoever for any damage caused by malfunction of this product and other damage caused by use of this product.
- If the pump you bought conforms to special specifications not described in this manual, use the pump according to the details of the separate meetings, drawings, and approval documents.
- If the pump is used in a manner not specified by the manufacturer, the protection provided by the pump may be impaired.

Smoothflow Pumps enable accurate

1 Installation

Pages 13 and 14



2 Piping

Pages 15 to 21



3 Electrical wiring

Pages 22 to 25



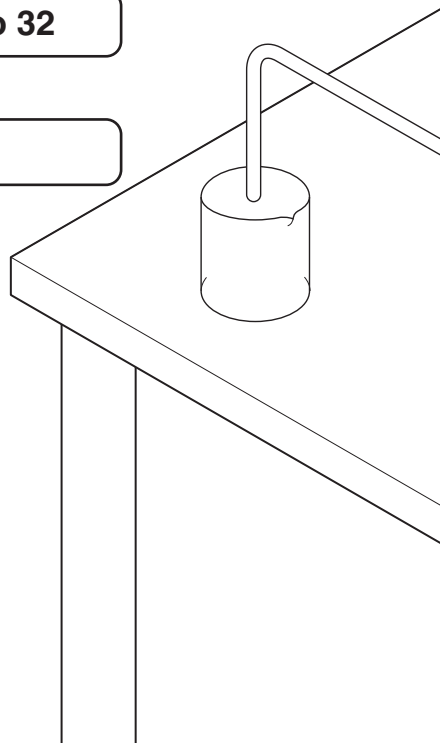
4 Calibration

Pages 29 to 32



5 Starting operation

Page 33

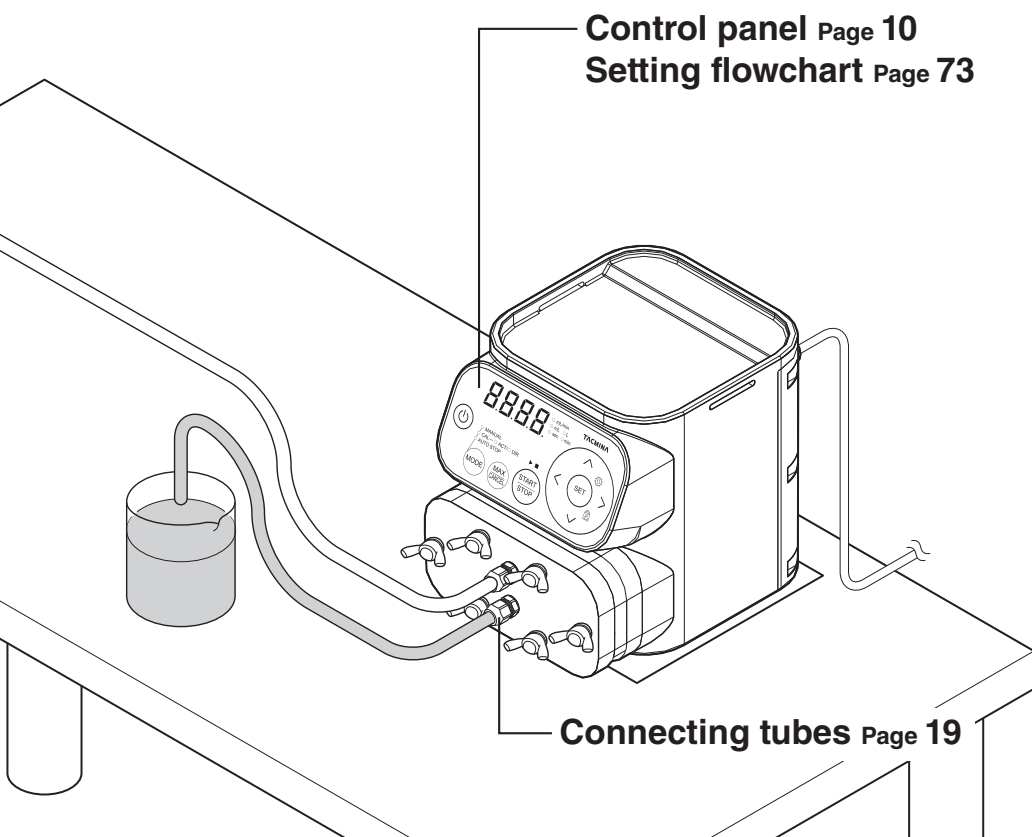


injection and simple control.

- If you have any problems with the pump



Troubleshooting Page 65



Control panel Page 10
Setting flowchart Page 73

Connecting tubes Page 19

How to operate the pump safely

In order to ensure that the pump will be operated correctly and safely, this operation manual contains some guidelines for the user in the form of important safety precautions and considerations that, depending on their seriousness, are categorized as set forth below. Be absolutely sure to heed these precautions and considerations.



WARNING

- This is used to indicate a condition or action that may result in death or serious injury if the instructions given are ignored and the operations are performed incorrectly.



CAUTION

- This is used to indicate a condition or action that may result in injury and/or damage to personal property if the instructions given are ignored and the operations are performed incorrectly.

IMPORTANT

- This is used to indicate a condition or action that must be established or carried out in order to maintain the performance and service life of the equipment.

NOTE

- This is used to indicate supplementary information.

Conditions of use



WARNING

- Do not use this pump in explosion-proof areas or in explosive or combustible atmospheres.



CAUTION

- This pump can only be used to transfer liquids. Do not use this pump for any other applications. Otherwise there is a risk of accident or malfunction.
- A liquid containing slurry cannot be injected into a sheet valve type.
- Do not use this pump in a wet location.*¹

*¹ The term wet location refers to a location where water or some other conductive liquid may exist and to a location where it is easy for the human body impedance to decrease due to wet contact between the human body and the machine or between the human body and the surrounding environment.

- **Do not use the pump outside the following usage ranges. Doing so may cause malfunctions.**

Ambient temperature/humidity	0 to 40°C ^{*2} /85%RH or less
Pollution degree	2
Altitude	1000m or less
Transfer liquid temperature	0 to 40°C (no freezing) 0 to 60°C for the Q/QI/QT-500/100-6T depending on the conditions (no freezing) ^{*3}
Transfer liquid viscosity	Q/QI/QT-500:50mPa·s or less Q/QI/QT-100/60:200mPa·s or less Q/QI/QT-30/10:100mPa·s or less
Maximum discharge pressure	Q/QI/QT-500/100:0.3MPa Q/QI/QT-60:0.6MPa Q/QI/QT-30:1.0MPa Q/QI/QT-10:2.0MPa

^{*2} -10 to 50°C during transport and storage.

^{*3} Contact TACMINA for the conditions.

Transportation, installation, & piping



WARNING

- Do not use this pump in explosion-proof areas or in explosive or combustible atmospheres.
- Install the pump in a location that cannot be accessed by anyone but control personnel.



CAUTION

- Take preventative measures such as a chemical drainage ditch that is capable of handling the flow of the transfer liquid.
Implement the measures so that the fluid level does not rise up to the surface where the pump is installed.
- Do not subject the pump to strong impacts.
- Keep the product level while transporting it. If the product is tilted by 10° or more, it may fall over.
- If this pump has been dropped or damaged, consult your vendor or a TACMINA representative. Using a dropped or damaged pump may result in accidents and/or malfunctions.
- Installation work must be performed by individuals who have received the required training.
- Do not install the pump in humid or dusty locations. Doing so may cause electric shock or malfunctions.
- This pump has an IP65 or equivalent construction^{*1}, but install it in a location where it is not exposed to direct sunlight, wind, or rain and where there is no chance of the pump being submerged in water. Failing to follow this instruction may damage the pump or shorten its service life. If you will install the pump outdoors, we recommend installing a cover over the pump.^{*2}

^{*1} Evaluated by an organization not related to UL.

^{*2} UL-listed models (ULP types) are all rated for indoor-use only.

- When a shut-off valve is located on the discharge-side piping and when there is a risk of blockage, be sure to install a relief valve on the piping immediately on the discharge side of this pump.
- If there is a chance of the fluid solidifying or freezing due to reasons such as using water-diluted solutions in areas where the temperature is low, install a heating apparatus or heat insulation. The fluid solidifying or freezing may lead to damage to the pump or surrounding equipment.
- The water used for the shipment tests may remain in the liquid-end section of the pump.
If the pump will transfer chemicals that harden or give off gas when they react with water, be absolutely sure to drain the water and dry off the liquid-end section prior to use.
- The discharge volume cannot be adjusted by operating valves on the discharge piping.
- The pump head and the joints are not designed to support the piping. Ensure that the pump and pipe joints will not be subjected to any excessive force that might be exerted by, for instance, the weight of the piping or the shifting of the pipe joints out of position.
- Generally speaking, the pressure resistance of hoses and tubes decreases when they reach high temperatures. If you will use commercially available hoses and tubes, be sure to use items that not only are resistant to chemicals but that also conform to the temperature and pressure under which they will be used. Failing to do so may cause hose or tube damage, which will cause chemicals to spray out.
- The hose and tube durability varies greatly depending on factors such as the chemical used, temperature, pressure, and ultra-violet rays. Inspect the parts and replace any that have deteriorated.

Electrical wiring



WARNING

- Do not use this pump in explosion-proof areas or in explosive or combustible atmospheres.
- The wiring must be done by a qualified electrician or somebody with electrical knowledge.
- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.
- Do not disassemble the pump body.
- When connecting the pump to another electronic device using a signal cable, such as when controlling the pump from an external device or when controlling another electronic device using the output signal from the pump, check the specifications of both the pump and the other device to ensure the connection is correct.
- To prevent electric shock, fire, etc., use a device insulated from the high-voltage section when connecting the signal cable, and do not apply a voltage higher than the signal rate to the pump.



CAUTION

- Connect the wires after checking the supply voltage. Do not connect the wires to a power supply that is not within the rated voltage range.*1

*1 All UL-listed models (ULP types) come with a plug, not lead wires.

Operation & maintenance



WARNING

- Install the pump in a location that cannot be accessed by anyone but control personnel.
- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.
- When there is a problem (such as when smoke appears or there is a burning smell), shut down the pump immediately, and then contact your vendor or a TACMINA representative. Otherwise, there is a risk of fire, electric shock, malfunction, or accident.
- Check if the valves are open before operating the pump. If you have forgotten to open a valve or foreign objects are blocking the piping on the discharge side of the pump, an excessive pressure rise that will exceed the pump's specification ranges may occur, liquid may spray out, or piping may be damaged, which is dangerous.
- Do not disassemble the pump body.
- Before disassembling the liquid-end section, be sure to turn off the power and check that no voltage is being applied to the pump. Do not disassemble this section after simply using the key to stop the pump. Hang a sign on the power switch indicating that work is in progress so as to prevent the power from being turned on again during the course of work.
- When working on the liquid-end section of the pump, wear protective gear suited to the chemical concerned (such as rubber gloves, a mask, protective goggles and work overalls that are resistant to chemical).
- When transferring a chemical liquid, carefully review the SDS for the chemical and wear protective gear listed on the SDS.
- If the liquid poses a fire risk, pay attention to the usage environment and take anti-static measures to prevent static from occurring."
- Before maintaining or repairing the pump, be sure to release the discharge-side pressure, drain the chemicals from the liquid-end section, and wash the pump with deionized water.
- When blowing the pump head with air, use a syringe or other tool. Blowing compressed air from a compressor may deform the sheet valve causing a blockage.



CAUTION

- Set the relief valve pressure to a value that is 120% or less of the pump's normal operation pressure.
- Before starting operation, secure the piping in place and check that the connections have been tightened.

Other precautions



CAUTION

- Do not modify or alter the pump.
- The materials of the parts used in this pump are indicated in the provided diagrams and similar documents. When disposing of the pump, do so after first giving careful consideration to the appropriate disposal method for each material according to the laws and regulations in the area where the pump will be disposed of. Alternatively, contract the disposal of the pump to a dedicated waste disposal company.

Checking the product

After unpacking the pump, check the following.

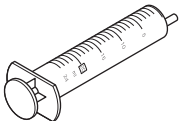
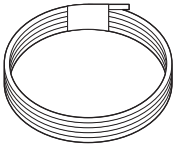
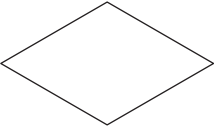
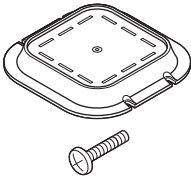
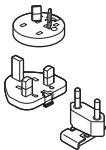
- (1) Is the pump the one that was ordered?
- (2) Do the details on the pump's nameplate match what was ordered?
- (3) Are all the accessories included?

Check the included accessories against the list of accessories shown below.

- (4) Has the pump sustained any damage from vibration or impact during transit?
- (5) Have any of the screws come loose or fallen out?

Every care is taken by TACMINA in the shipment of its pumps, but if you come across anything untoward, please contact your vendor or a TACMINA representative.

Accessories

Syringe (24mL)	Tube*1 *2 ($\phi 4 \times \phi 6$)	Nonslip sheet	Pump stand set*3 • Pump stand • Cross recessed self-tapping screw
 x1	 2m	 x1	 x1
Mounting bolt set • Cross recessed hexagon head bolts with washers • Flange nuts	Operation manual	Plug set*4	
 x4	 x1	 x1	

*1 The tube is made of polyolefin resin for the VE and VF types and is made of PTFE for the TT and 6T types.

*2 For Q□-500 models, $\phi 4 \times \phi 6$ (1m) on the discharge side and $\phi 8 \times \phi 10$ (1m) on the suction side.

*3 Comes already installed on the pump for Q/QI/QT-10.

*4 Plug types O, C, BF are included.

Complies with UL Standards only when a Type A plug is used.

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Introduction

Installation

Operation

Maintenance

Troubleshooting

Specifications

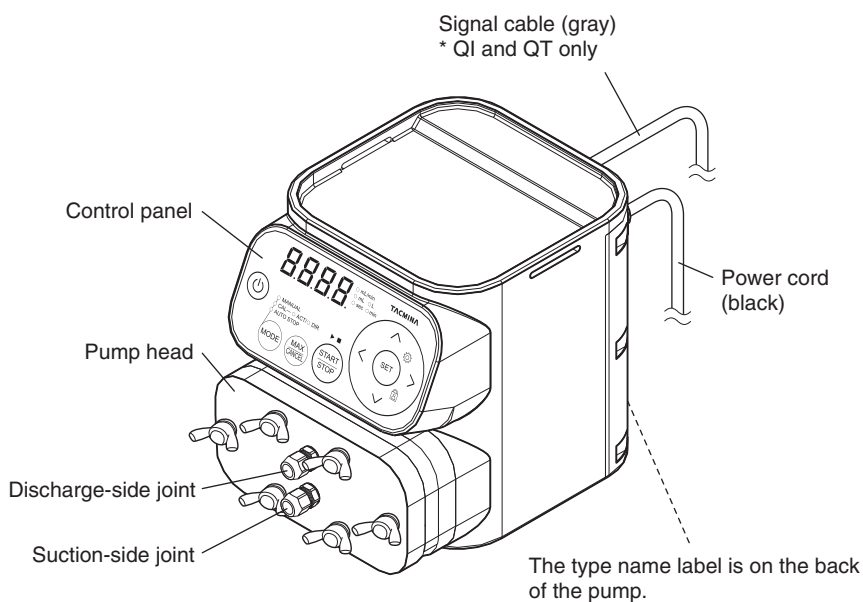
Others

Introduction

This diaphragm pump is capable of accurately feeding a constant amount of liquid in a constant amount of time.

Discharge-side pulsation is nearly nonexistent, which enables a stable and continuous transfer of fluids.

Structure

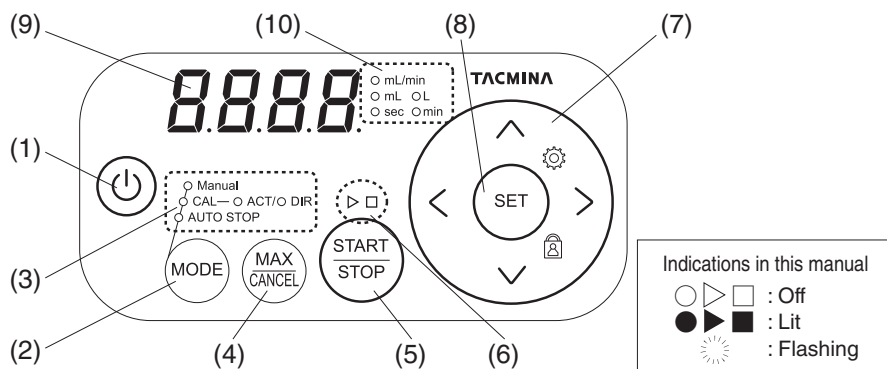


■Name plate

- (1) Brand Name
- (2) Serial Number
- (3) Model Code
- (4) Max. Capacity (mL/min)
- (5) Max. Pressure (bar or MPa)
- (6) Power Supply
- (7) Manufacturer

Control panel

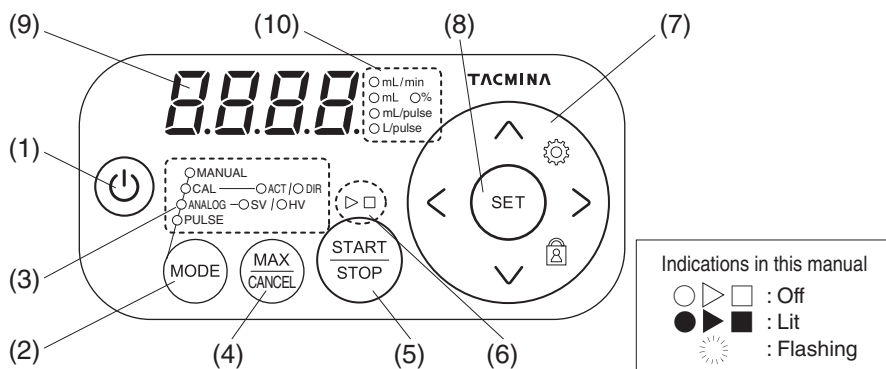
Q (standard type)



No.	Name	Function
(1)	Power key	Turns the power on/off.
(2)	"MODE" key	Use this key to switch the mode. The pump switches to a different mode each time you press this key.
(3)	Mode indicator lamp	Displays the current mode. "MANUAL": Manual operation mode "CAL" : Calibration mode "AUTO STOP" : Auto-stop operation mode
(4)	"MAX/CANCEL" key	While this key is pressed, the pump operates at the maximum flow rate. When you are setting the amount to inject or the parameters, use this key to cancel settings. Use this key to clear errors.
(5)	"START/STOP" key	Use this key to start/stop the pump.
(6)	Operation status indicator lamp	Displays the pump's operation status. ■ : Pump stopped ▶ : Pump operating
(7)	Arrow keys	Use these keys to perform operations such as changing the flow rate.
(8)	"SET" key	Use this key to perform operations such as changing parameters and calibrating the pump.
(9)	Display	Displays the flow rate and setting values.
(10)	Unit indicator lamp	The unit for the displayed value lights.

Control panel

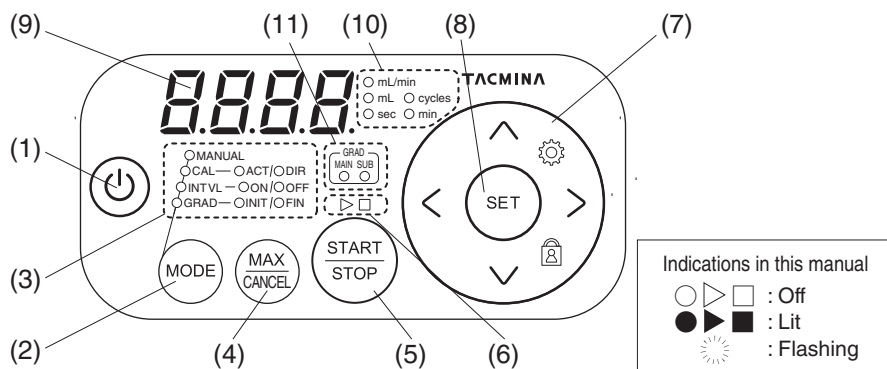
QI (I/O signal control type)



No.	Name	Function
(1)	Power key	Turns the power on/off.
(2)	"MODE" key	Use this key to switch the mode. The pump switches to a different mode each time you press this key.
(3)	Mode indicator lamp	Displays the current mode. "MANUAL": Manual operation mode CAL : Calibration mode "ANALOG": Analog-input proportional operation mode "PULSE": Pulse-input proportional operation mode
(4)	"MAX/CANCEL" key	While this key is pressed, the pump operates at the maximum flow rate. When you are setting the amount to inject or the parameters, use this key to cancel settings. Use this key to clear errors.
(5)	"START/STOP" key	Use this key to start/stop the pump.
(6)	Operation status indicator lamp	Displays the pump's operation status. ■ : Pump stopped ▶ : Pump operating
(7)	Arrow keys	Use these keys to perform operations such as changing the flow rate.
(8)	"SET" key	Use this key to perform operations such as changing parameters and calibrating the pump.
(9)	Display	Displays the flow rate and setting values.
(10)	Unit indicator lamp	The unit for the displayed value lights.

Control panel

QT (timer control type)



No.	Name	Function
(1)	Power key	Turns the power on/off.
(2)	"MODE" key	Use this key to switch the mode. The pump switches to a different mode each time you press this key.
(3)	Mode indicator lamp	Displays the current mode. "MANUAL": Manual operation mode CAL : Calibration mode "INTVL": Interval operation mode "GRAD": Gradient operation mode
(4)	"MAX/CANCEL" key	While this key is pressed, the pump operates at the maximum flow rate. When you are setting the amount to inject or the parameters, use this key to cancel settings. Use this key to clear errors.
(5)	"START/STOP" key	Use this key to start/stop the pump.
(6)	Operation status indicator lamp	Displays the pump's operation status. ■ : Pump stopped ► : Pump operating
(7)	Arrow keys	Use these keys to perform operations such as changing the flow rate.
(8)	"SET" key	Use this key to perform operations such as changing parameters and calibrating the pump.
(9)	Display	Displays the flow rate and setting values.
(10)	Unit indicator lamp	The unit for the displayed value lights.
(11)	MAIN and SUB indicator lamps	Displays the main/sub unit setting during gradient operation. "MAIN": Main unit "Sub": Sub unit

Installation



WARNING

- Do not use this pump in explosion-proof areas or in explosive or combustible atmospheres.
- Install the pump in a location that cannot be accessed by anyone but control personnel.

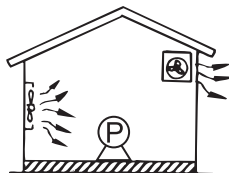
Installation location

- Whenever possible, avoid installing the pump in a location that will shorten its service life. If you will install the pump outdoors, we recommend installing a cover over the pump.

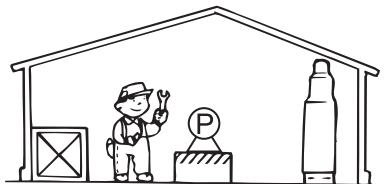
Locations that will shorten the service life of the pump

- Locations subject to direct sunlight
- Locations where corrosive gases are generated
- Locations exposed to the wind and rain
- Poorly ventilated locations
- High humidity or dusty locations

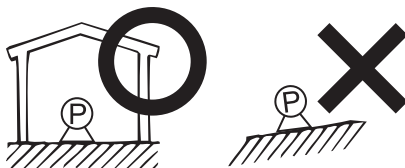
- Install the pump in a location that has good ventilation in the summer and where the transfer liquid will not freeze in the winter.



- Provide adequate space around the pump to facilitate maintenance and inspections.



- Place the pump on a level location and secure it so that it will not vibrate. Installing the pump at an angle may result in discharge problems or in the inability of the pump to discharge.



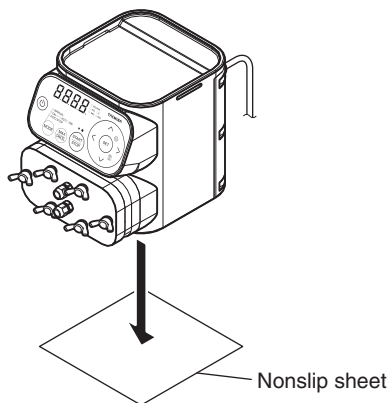
Installation

When not using the pump stand

* The Q/QI/QT-10 pump head is heavy, so be sure to use the included stand.

The pump may vibrate depending on the operating conditions. Use a nonslip sheet or use a pump base to secure the pump in place.

Install the pump on top of the nonslip sheet.

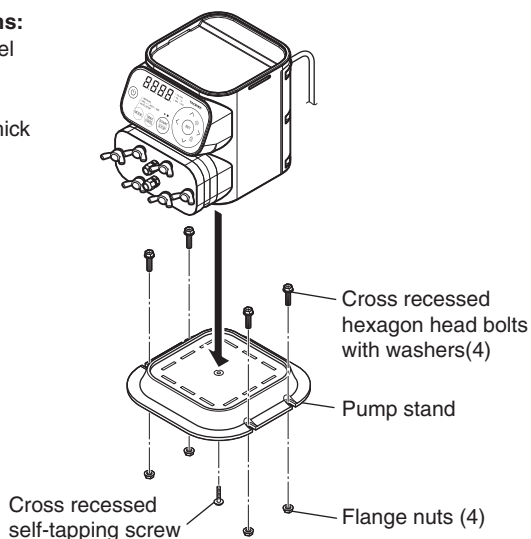


When using the pump stand

- (1) Use the cross recessed self-tapping screw to fix the pump onto the pump stand.
- (2) Use the cross recessed hexagon head bolts with washers and the flange nuts to install the pump stand.

* **Pump stand installation conditions:**

- Install the stand horizontally in a level location.
- Fix the pump to a SUS plate or an equally strong plate at least 2 mm thick with a tightening torque of 2 N·m.



Piping

Requests during piping

● Pump head joints



CAUTION

- The pump head and the joints are not designed to support the piping. Ensure that the pump and pipe joints will not be subjected to any excessive force that might be exerted by, for instance, the weight of the piping or the shifting of the pipe joints out of position.

● Piping size and length

- Excessively long piping on the suction or discharge side may result in increased pressure loss, which may cause the pressure to exceed the pump's allowable pressure, may cause an excessive amount of liquid to be discharged, or may generate suction/discharge defects.
- When extending the piping, the pressure loss might exceed the pump's maximum discharge pressure, so thicker piping will be required.

See the following table to select the ideal piping sizes.

● Upper limits on piping length

The upper limit on the piping length varies depending on the tube diameter and the set flow rate of the pump.

Q/QI/QT-500

Tube inner diameter	During 500mL/min operation		During 300mL/min operation		During 100mL/min operation	
	Suction side	Discharge side	Suction side	Discharge side	Suction side	Discharge side
φ2	Not possible	3m	Not possible	8m	Not possible	30m
φ4 *1	Not possible	30m	Not possible	30m	3m	30m
φ6	1m	30m	1.5m	30m	10m	30m
φ8 *1	2m	30m	3m	30m	10m	30m

Q/QI/QT-100

Tube inner diameter	During 100mL/min operation		During 50mL/min operation		During 10mL/min operation	
	Suction side	Discharge side	Suction side	Discharge side	Suction side	Discharge side
φ1	Not possible	1.5m	Not possible	6m	2m	30m
φ2	0.5m	30m	2m	30m	10m	30m
φ4 *1	3m	30m	10m	30m	10m	30m

Piping

Q/QI/QT-60

Tube inner diameter	During 60mL/min operation		During 30mL/min operation		During 10mL/min operation	
	Suction side	Discharge side	Suction side	Discharge side	Suction side	Discharge side
φ1	Not possible	5m	1m	15m	2m	30m
φ2	0.5m	30m	1.5m	30m	7m	30m
φ4 * ¹	1m	30m	3m	30m	10m	30m

Q/QI/QT-30

Tube inner diameter	During 30mL/min operation		During 10mL/min operation		During 5mL/min operation	
	Suction side	Discharge side	Suction side	Discharge side	Suction side	Discharge side
φ1	Not possible	20m	Not possible	30m	1m	30m
φ2	1m	30m	2m	30m	8m	30m
φ4 * ¹	3m	30m	10m	30m	10m	30m

Q/QI/QT-10

Tube inner diameter	During 10mL/min operation		During 5mL/min operation		During 1mL/min operation	
	Suction side	Discharge side	Suction side	Discharge side	Suction side	Discharge side
φ1	Not possible	30m	Not possible	30m	5m	30m
φ2	2m	30m	6m	30m	10m	30m
φ4 * ¹	5m	30m	10m	30m	10m	30m

*¹ Included tube

- * These values correspond to the case in which the piping is level. The upper limits are smaller if there are height differences between different parts of the piping.
- * These values correspond to the case in which clean water is transferred. The upper limits are smaller if the liquid has a high viscosity.
- * If you require piping that is longer than the lengths given in the above table, contact TACMINA.
- * If the liquid continues to flow within the piping even when the pump is stopped and an excessive amount of liquid is discharged, use a valve such as an anti-siphon check valve or a back pressure valve to apply back pressure.
- * If overfeeding occurs, increase the inner diameter of the suction side tube.

Piping

●Pulsation in the suction-side piping

This pump suppresses pulsation on the discharge side, but pulsation occurs on the suction side.*1

*1) Pulsation

This pump's suction side generates unique pulsation. This pulsation has sine curve characteristics, and the instantaneous flow rate is approximately 2 times the average flow rate. For example, this means that an instantaneous flow rate of 200mL/min is indicated for a 100mL/min model.

For this reason, when selecting piping, the piping differs from that used on a continuous flow pump, such as a centrifugal pump, in that a value of the operating flow rate (mL/min) times 2 must be used.

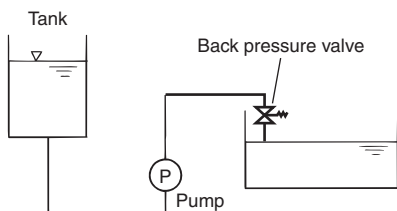
●Preventing the insertion of foreign objects

Foreign objects such as debris and aggregates inside the pipes entering into the pump head may result in discharge problems. Implement countermeasures such as installing filters.

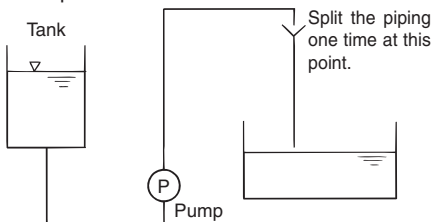
●When injecting fluid below the level of the liquid in the tank

When the end of the discharge-side piping is lower than the level of the liquid in the tank, siphoning will cause the liquid to flow down naturally. To prevent this, install a back pressure valve. If you cannot install a back pressure valve, split off the piping at a location near the injection point and higher than the liquid level in the tank.

Example 1:



Example 2:



●Other



CAUTION

- If there is a chance of the fluid solidifying or freezing due to reasons such as using water-diluted solutions in areas where the temperature is low, install a heating apparatus or heat insulation. The fluid solidifying or freezing may lead to damage to the pump or surrounding equipment.

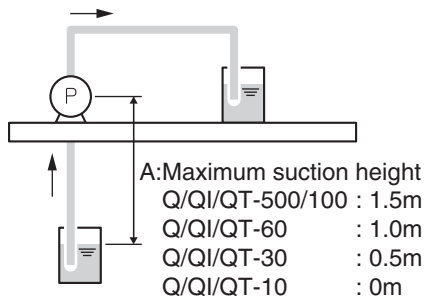
Piping

Recommended piping example

- To ensure safety, we recommend that you install the pump at a position that is equal to (level piping) or higher than (upwards suction piping) the level of the liquid in the tank on the suction side. However, when a flammable liquid or hazardous chemical is used, we do not recommend this installation method as there is a risk of liquid leakage due to siphoning.
- The maximum suction height (A in the following figure) varies depending on the model of the pump. It may also vary depending on the properties of the liquid.
- When the pump is installed at a position lower than the level of the liquid in the tank on the suction side or when the tip of the discharge-side piping is lower than the level of the liquid in the tank on the suction side, siphoning may cause the liquid to flow down even when the pump is stopped. In this situation, use a commercially available back pressure valve, check valve, or a similar instrument to apply back pressure.
(When using this pump with pressure booster piping, we recommend that you use a check valve with a cracking pressure of 40kPa or more.)
- If siphoning occurs due to the configuration of the pipes, use a valve on the tank side to prevent continuous liquid flow before performing maintenance.
- Exercise caution when removing the tubes (such as when performing maintenance) as the remaining liquid in the pump may spray out.
- Pulsations occur on the suction side. Exercise caution to ensure that the tubes remain inside the containers.

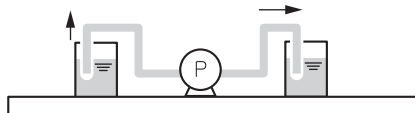
Upwards suction piping

(The pump is higher than the level of the liquid in the tank on the suction side.)



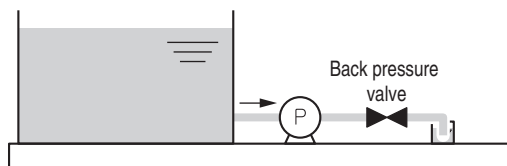
Level piping

(The pump is at the same height as the level of the liquid in the tanks on the suction and discharge sides.)



Pressure booster piping

(The pump is lower than the level of the liquid in the tank on the suction side.)



Piping

Connecting tubes

Cut the included tube into segments with the required lengths, and then connect these to the suction-side joint and the discharge-side joint.

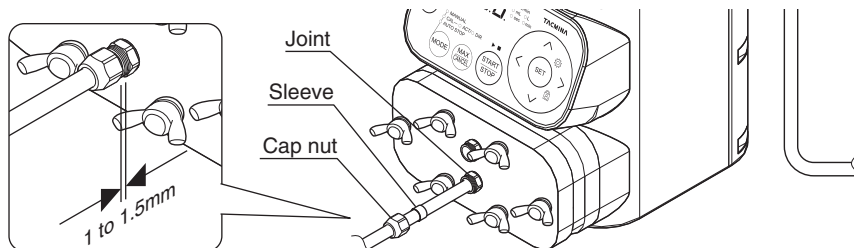
●VE / VF type

- (1) Set a cap nut and sleeve on the tube, and then connect it to the joint.
- (2) Tighten the cap nut by hand.

Continue tightening the cap nut until the gap between it and the joint is approximately 1 to 1.5mm.

If it is difficult to tighten the cap nut by hand, use a wrench to retighten the cap nut by 1 to 2 turns (until the joint on the pump side cannot rotate).

- * Do not tighten the cap nut excessively. Doing so may lead to tube deformation or damage.
- * It is easy for the stress relaxation phenomenon to occur in the resin joint, and liquid may leak from the threaded part. Retighten the cap nut to eliminate leakage. If retightening no longer stops leakage, replace the joint.
- * When reusing a tube that has been removed, first cut off the deformed part of the tube tip.
- * When replacing the tube with a new one, replace the sleeve with a new one if it is difficult to pass the tube through the sleeve.



Piping

●TT type

(1) Pass the tube through the nut, and then insert the tube until its tip reaches the back of the joint.

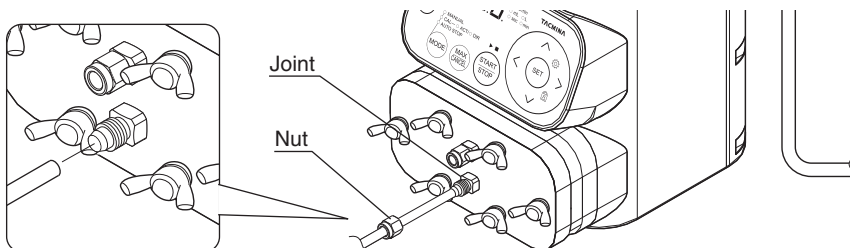
(2) Gently tighten the nut by hand until it becomes stiff.

(3) Use a wrench to fix the joint in place so that it does not turn, and then use another wrench to rotate the nut through an additional 1 and 1/4 turns (1.25 turns).

* The reference value for the tightening torque is 2.3 kgf·cm. The torque varies depending on various conditions, but do not use a tightening torque that is 1.5 times the reference value or more. Excessive tightening may result in deformation or damage.

* It is easy for the stress relaxation phenomenon to occur in the resin joint, and liquid may leak from the threaded part. Retighten the cap nut to eliminate leakage. If retightening no longer stops leakage, replace the joint.

* When reusing a tube that has been removed, first cut off the deformed part of the tube tip.

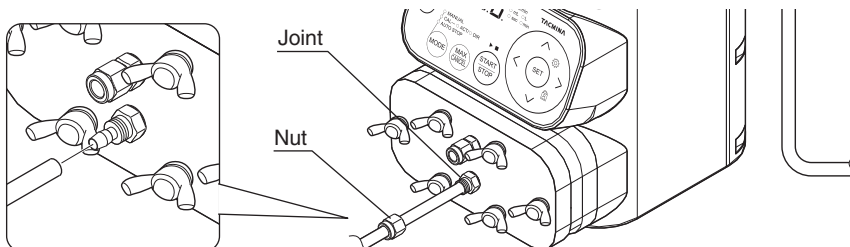


●6T type

(1) Pass the tube through the nut, and then insert the tube until its tip reaches the base of the protrusion on the joint.

(2) Use a wrench to fix the joint in place so that it does not turn, and then use another wrench to tighten the nut until it comes in contact with the joint.

* When reusing a tube that has been removed, first cut off the deformed part of the tube tip.



Piping

●When using a tube other than that included with the accessories

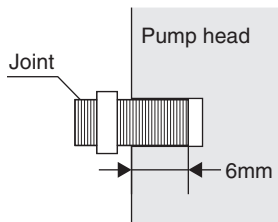
- Use a tube with good external accuracy.
- Cut the tube at a right angle so that the opening maintains a perfect circle, and then check that the outer surface is not damaged.
- Flexible tubes such as those made from vinyl chloride, polyethylene, or urethane are not appropriate for use with the joints included in the accessories. When using tubes like these, attach an insert or a similar device (contact the tube's manufacturer) in order to change the tube to one that can be supported by the joints.

Joints

●Attaching joints

When you have removed joints for purposes such as cleaning and when you are replacing the joints with ones not included in the accessories, attach the joints by adhering to the following points.

- Be sure to wrap thread seal tape around the threads.
- Use a screw-in depth of 6 mm.
A depth that is too deep may damage the pump head or joints.
A depth that is too shallow may result in a defective seal or looseness.



●When using a joint other than that included with the accessories

- Use an R1/8 joint.

Electrical wiring



WARNING

- Do not use this pump in explosion-proof areas or in explosive or combustible atmospheres.
- The wiring must be done by a qualified electrician or somebody with electrical knowledge.
- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.
- Do not disassemble the pump body.
- When connecting the pump to another electronic device using a signal cable, such as when controlling the pump from an external device or when controlling another electronic device using the output signal from the pump, check the specifications of both the pump and the other device to ensure the connection is correct.
- To prevent electric shock, fire, etc., use a device insulated from the high-voltage section when connecting the signal cable, and do not apply a voltage higher than the signal rate to the pump.

Electrical wiring

Connecting the signal cable (QI and QT only)

The signal cable is an eight-core wire. Connect to the necessary devices through a terminal block or a similar apparatus.

The roles of the wires are shown below.

For wires with the same color, differentiate them by the difference in the dot positions.

Wire color	Signal	Role	Dot position
pink	DI1 (+)	Digital input 1	
pink	DI2 (+)	Digital input 2	
green	INCOM (-)	Digital input common	
blue	DO1 (+)	Digital output 1	
blue	DO2 (+)	Digital output 2	
grey	OUTCOM (-)	Digital output common	
orange	AI +	Analog input +	
green	AI -	Analog input -	

●About digital input

a) When applying a no-voltage contact signal

Apply a no-voltage contact pulse from a device such as a pulse-transmitting flow meter to INCOM (green) and DI1 (pink) or DI2 (pink). In this situation, the signal has no polarity.

Use a pulse signal with low chattering. This is not suitable for general-purpose control relay contacts.

b) When applying an open collector (drain) signal

The current orientation is determined by the characteristics of the elements of open collectors, open drains, and other semiconductor contacts. Connect the collector (drain) to DI1 (pink) or DI2 (pink) and the emitter (source) to INCOM (green).

●About analog input

Connect the signal cable (4 to 20mA DC) so that AI+ (blue) is positive and AI- (red) is negative.

●About signal specifications

See "I/O signal specifications" on page 71.

NOTE

- You can use "Parameter settings" (page 53) to change the assignments of digital inputs 1 and 2 and digital outputs 1 and 2.

Electrical wiring

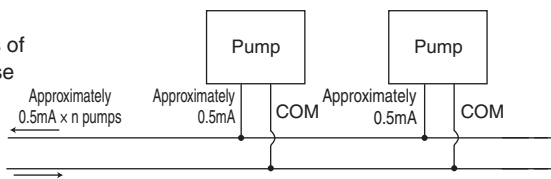
Signal cable distribution (QI and QT only)

■When not using a signal distributor

●Digital signal

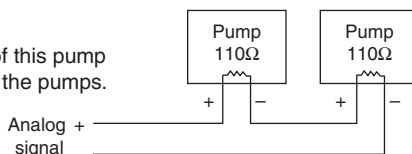
You can connect multiple instances of this pump in parallel and apply pulse signals and pause/run signals to the pumps.

Open collector
or
no-voltage contact signal



●Analog signal

You can connect multiple instances of this pump in series and apply analog signals to the pumps.

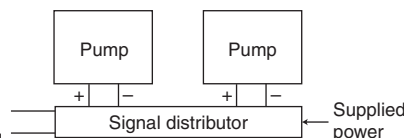


* If you remove a pump during maintenance or similar operations or if a pump is malfunctioning, the analog signal will be interrupted, and the other pumps will stop. If you want to ensure that these other pumps continue operating even in these situations, install a signal distributor.

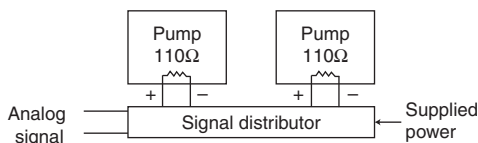
■When using a signal distributor

●Digital signal

Open collector
or
no-voltage contact signal



●Analog signal



■Digital signal input precautions

If you are using an open collector for the input, ensure that the leak current is small and the residual voltage is 1V or less. If you are using an SSR, we recommend that you use the OMRON G3TA-IDZR02S.

■Digital signal output precautions

If you are using an SSR or a similar device to receive pulse output and alarm output, exercise caution regarding the current capacity.

We recommend that you use the OMRON G3F-203SN for the SSR.

Operation



WARNING

- Install the pump in a location that cannot be accessed by anyone but control personnel.
- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.
- When there is a problem (such as when smoke appears or there is a burning smell), shut down the pump immediately, and then contact your vendor or a TACMINA representative. Failing to follow this instruction may result in fire, electric shocks, malfunctions, or accidents.
- Check if the valves are open before operating the pump. If you have forgotten to open a valve or foreign objects are blocking the piping on the discharge side of the pump, an excessive pressure rise that will exceed the pump's specification ranges may occur, liquid may spray out, or piping may be damaged, which is dangerous.
- When transferring a chemical liquid, carefully review the SDS for the chemical and wear protective gear listed on the SDS.

Before the first operation

- Check that the usage conditions are suited to the pump. (See "Conditions of use" on page 4.)
- Flush the piping with a safe liquid such as water and check that there are no leaks or blockages.

Wash out or flush the piping so that no foreign material, such as cutting debris from the piping construction, remains in the piping.

Operation

Before operation

For safety, check the following items before operation.

Check location	Details of check/action to perform	Remarks
Pump head Joints	Check for looseness. If the joints are loose, retighten them.	When first operating the pump after maintenance, retighten in the same manner.
Chemical tank	Check if the chemical amount is sufficient. If the amount is not sufficient, fill the tank.	
Piping	Check for piping disconnections and damage. Reconnect any disconnections and repair any damage.	
Valves (suction side and discharge side)	Check that the valves are open. If a valve is closed, open it.	Closed valves can cause dangerous situations in which the pressure rises excessively, liquid gushes out, or the pipes are damaged.
Power supply	Check that the pump is correctly connected to the specified power supply.	Failure to follow this instruction may lead to circuit damage or the motor burning out.

During operation

For safety, check the following items during operation.

Check location	Details of check/action to perform	Remarks
Pump head	Check for liquid leakage. If liquid leakage is discovered, stop the pump and inspect the bolts for uneven tightening or looseness while retightening any loose connections.	Also see "Liquid is leaking from the pump head." in the troubleshooting. (Page 68)
Joints	Check for liquid leakage. If liquid leakage is discovered, stop the pump and retighten any loose connections.	Also see "Liquid is leaking from the joints." in the troubleshooting. (Page 67)
Discharge-side pressure	Check for motor step-out (a state similar to idling). Check for vibration noises. If motor step-out has occurred, a pipe or valve may be blocked. Inspect the piping.	Also see "A vibration noise can be heard." in the troubleshooting. (Page 68)
Drive component/pump	Check for heat being produced and unusual noises.	

When stopping operation for a long period of time

When stopping pump operation for a long period of time or when resuming operation after a prolonged shutdown, perform the following work.

To stop

- (1) Clean the inside of the pump head.
Run the pump for 30 minutes with clean water or a cleaning solution.
- (2) Remove the clean water or cleaning solution.
- (3) Stop the pump, and then completely turn off the power.
- (4) Put a cover on the pump.
Protect the pump from dust accumulation and corrosive environments.

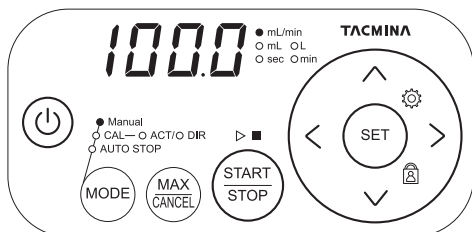
To resume

- (1) Check inside the tank for sediment deposits and for problems such as the liquid turning cloudy.
If the quality of the liquid has deteriorated, first wash the inside of the tank, and then replace the entire volume of liquid with clean liquid.
- (2) Check that no debris is stuck to the inside of the pump head or the sheet valve.

Turning the power on/off

Press the power key (⏻) for 1 second or more.

In the factory default configuration, even when the main power supply turns on (when the pump is connected to a power outlet), the pump will not turn on until you press the power key. Also, immediately after the power turns on, the pump will be stopped, regardless of the operating state that was in use when the pump was last turned off.



You can also change the operation as shown below by following the instructions under "Changing parameters" (page 50).

Mainly use this function when the pump is used as an embedded component in a device.

- Automatically turn on the pump, without pressing the pump's power key, when the main power supply turns on.
(Parameter P1-1)
- When the main power supply turns on, return the pump to the operating state that was in use when the main power supply was last turned off.
(Parameter P1-2)

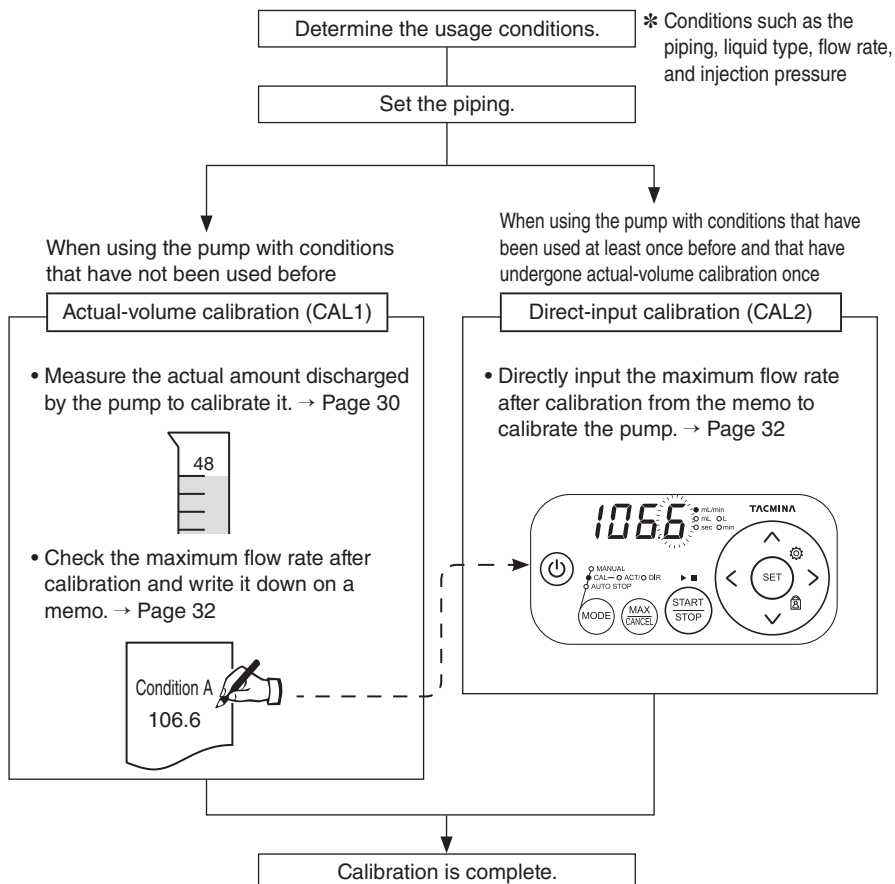
Calibration

You can set an accurate flow rate by measuring the amount of liquid that is discharged under the actual usage conditions and calibrating the pump.

Perform calibration in the following situations.

- The first time that you use the pump
- When the usage conditions change (changes to the liquid, piping, or injection pressure) (changes to the liquid, piping, or injection pressure)
- When the pump has not been used for a long period of time
- When the set flow rate and the actual discharge amount do not match

Calibration flowchart



Calibration

Measuring the actual amount discharged and calibrating (CAL1)

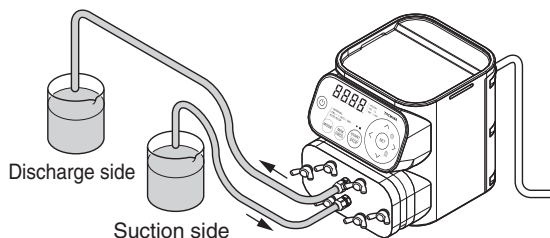
(1) Set the piping.

The amount discharged will vary depending on the pressure within the piping. Perform calibration as close to the status with the actual piping as possible.

(2) Press the "MODE" key until the "Manual" lamp lights.



(3) Press the "START/STOP" key to operate the pump and fill the pump head and piping with the liquid.



* You can press the "MAX" key to temporarily operate the pump with the maximum flow rate. (See "MAX operation" on page 34.)

* The Q/QI/QT-10 cannot suction liquid with an empty pump head, so you have to use the syringe to suction liquid before starting operation.

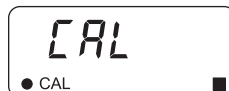
The Q/QI/QT-500/100/60/30 can perform self-priming, but when it takes time for the liquid to be suctioned, use the syringe to suction the liquid. (See "Using the syringe to suction the liquid" on page 34.)

●Before proceeding to the next step

- Circulate the liquid within the pump for a fixed amount of time, and then start the calibration after the pressure within the piping has stabilized.
- Check that liquid containing no air is discharged from the tip of the tube on the discharge side.
- Note that the tube being in contact with the suction-side container or suctioning air will affect the amount of liquid that is transferred and will prevent accurate calibration.

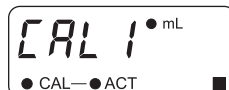
(4) Press the "MODE" key until the "CAL" lamp lights.

This switches the pump to calibration mode.



(5) Press the "SET" key until the "ACT" lamp lights.

"CAL1" is shown on the display.



(6) Press the "SET" key.

The flow rate setting value is displayed.



(7) Press the "SET" key once more.



Calibration

- (8) Change the value to the desired flow rate with the arrow keys.

< > : Select the digit. ^ v : Increase/decrease the value.
Settable range: 0.1 to (Maximum flow rate)

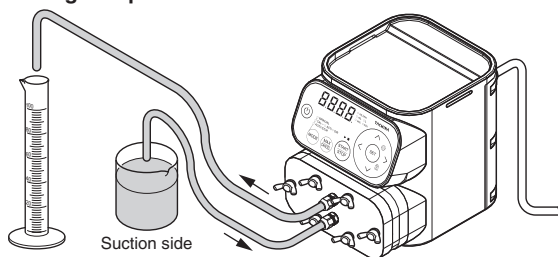
* You can obtain a more accurate calibration result by performing calibration with the flow rate that you actually use.



- (9) Press the "SET" key to confirm the flow rate.



- (10) At the outlet of the discharge-side piping, prepare a container for measuring the amount of discharged liquid.



- (11) Press the "START/STOP" key to start operation.

During operation, the accumulated discharge volume is counted and displayed.

To increase the accuracy, let the pump operate for a few minutes (2 minutes or more or 100mL or more is recommended).

The longer you let the pump operate, the more accurate the calibration results you will obtain.

* Up to 500mL can be measured.



- (12) After a few minutes of operation, press the "START/STOP" key to stop operation.

The accumulated discharge volume flashes.

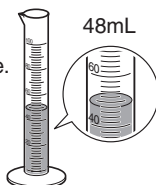
* If you stop the pump within 30 seconds of starting operation, the error message "E-09" will be displayed.
Press the "MAX/CANCEL" key to clear the error, and then perform the procedure again from step (4).



- (13) Measure the volume of the discharged liquid, and then use the arrow keys to enter this value.

< > : Select the digit.

^ v : Increase/decrease the value.



* You can obtain a more accurate calibration result by using a highly accurate measurement method such as an electronic balance.

- (14) Press the "SET" key to finish calibration.



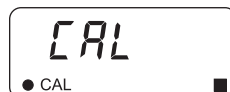
Calibration

Checking the maximum flow rate after calibration

The pump's maximum flow rate setting is changed by the calibration.

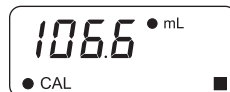
We recommend that you check the maximum flow rate after calibration and make a record of it, such as in a notebook. You can use "direct-input calibration" (page 32) to easily calibrate the pump to the same conditions from the second and later times that you need to perform calibration.

- (1) Press the "MODE" key until the "CAL" lamp lights.



- (2) Press the "MAX/CANCEL" key.

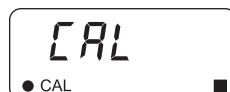
The maximum flow rate after calibration is displayed.



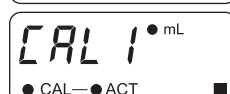
Using a value to perform calibration (CAL2)

To use the pump under the same conditions that you obtained through actual-volume calibration from the second and later times, you can easily perform calibration by directly entering the maximum flow rate after calibration, which you recorded (in a notebook, for example) in advance.

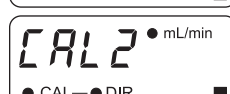
- (1) Press the "MODE" key until the "CAL" lamp lights.



- (2) Press the "SET" key.



- (3) Press the $\wedge$ or $\vee$ arrow key until the "DIR" lamp lights.
"CAL2" is shown on the display.



- (4) Press the "SET" key.



- (5) use the arrow keys to enter the maximum flow rate after calibration.

$\langle \rangle$: Select the digit. $\wedge \vee$: Increase/decrease the value.



- (6) Press the "SET" key to finish calibration.



IMPORTANT

- Direct-input calibration (CAL2) is a simple calibration method. If you require higher accuracy, perform actual-volume calibration (CAL1).

Manual operation

Set an arbitrary flow rate and operate the pump.

- (1) Press the "MODE" key until the "MANUAL" lamp lights.

The pump switches to manual operation mode.



- (2) Press the "SET" key.



- (3) Use the arrow keys to enter the flow rate.

< > : Select the digit. ^ v : Increase/decrease the value.

* At this point, the flow rate has not yet been changed.

* In the factory default configuration, the setting uses a unit of 0.1mL/min.

You can change this unit to 0.01mL/min by following the instructions under "Parameter settings" (page 50).



- (4) Press the "SET" key to confirm the flow rate.



- (5) Press the "START/STOP" key to start operation.

During operation, you can:

- Change the flow rate (described below).
- Temporarily run the pump at the maximum flow rate. ("Suctioning liquid/Air release" on page 34).



- (6) Press the "START/STOP" key to stop operation.



Changing the flow rate during operation

Even during pump operation, you can use steps (2) to (4) shown above to change the flow rate.



Suctioning liquid/Air release

MAX operation

You can force the pump to operate at the maximum flow rate.

Use this function in the following situations.

- To quickly transfer liquid to the pump head when the liquid transfer starts
- To release air from the inside of the piping or pump head

(1) During pump operation, press the "MAX/CANCEL" key.

While this key is pressed, the pump operates at the maximum flow rate.

The maximum flow rate is shown on the display.



NOTE

- It may take time for the Q/QI/QT-60/30/10 to release the air during MAX operation. Circulate the liquid within the pump until the air is released or use the syringe to suction the liquid.

Using the syringe to suction the liquid

The Q/QI/QT-10 cannot suction liquid with an empty pump head, so you have to use the syringe to suction liquid before starting operation.

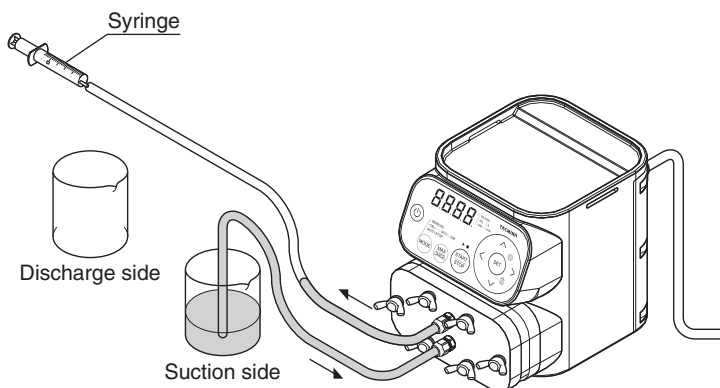
The Q/QI/QT-500/100/60/30 can perform self-priming, but when it takes time for the liquid to be suctioned, use the syringe to suction the liquid.

When you are using the included tube (with an inner diameter of 4mm), you can use the included syringe.

(1) Stop the pump.

(2) Insert the syringe into the tip of the discharge-side piping, and then suction the liquid to the pump.

When the pump head is full of liquid, remove the syringe, and then operate the pump.



Auto-stop operation (Q only)

If you set the flow rate and the timing with which to stop (the operation time or the accumulated discharge volume), the pump will stop automatically.

- (1) Press the "MODE" key until the "AUTO STOP" lamp lights.
The pump switches to auto-stop operation mode.



- (2) Press the "SET" key.



- (3) Use the arrow keys to set the flow rate (mL/min).
< > : Select the digit. ^ v : Increase/decrease the value.



- (4) Press the "SET" key.



- (5) Use the arrow keys to set the timing with which to stop the pump.



< > : Select the digit. ^ v : Increase/decrease the value.
Settable range: 0.1 to 999.9 (mL or L)
1 to 9999 (sec or min)

* In the factory default configuration, this is set to operation time with a unit of minutes.

You can change this unit to one of those shown below by using [P7-1] explained in "Setting parameters" (page 50).

- Accumulated discharge volume (mL or L)
- Operation time (sec or min)

- (6) Press the "SET" key to finish configuring the settings.



- (7) Press the "START/STOP" key to start operation.

The pump will stop automatically with the timing that you have set.



Analog-input proportional operation (QI only)

You can have the pump automatically change the flow rate according to an externally applied analog signal (4 to 20mA).

Setting examples

Use the combination of the "target value, SV," and the "maximum flow rate, HV," to set the control range of the flow rate.

■Meaning of terms

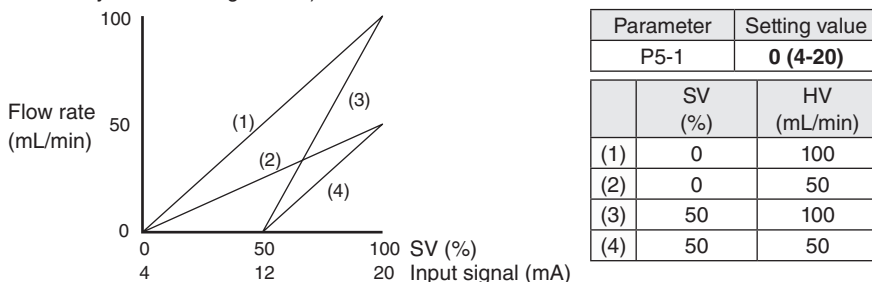
Target value, SV (%): The point where the line crosses the X axis on the proportion graph

Maximum flow rate, HV (mL/min): The flow rate at 100% (20mA)*¹ input

*¹ This is the flow rate with an input of 4mA when using negative polarity (20 to 4).

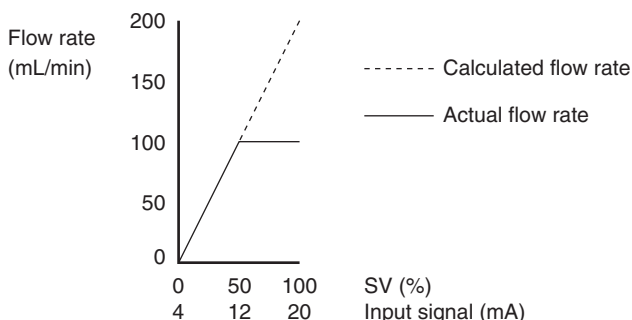
■Example 1: Input proportional operation with positive polarity (4 to 20mA)

If [P5-1] is set to [0] in the "Parameter settings" (page 51) and the input signal (mA) is mapped to the X axis and the flow rate (mL/min) is mapped to the Y axis, the result is a proportion graph in which the lines rise to the right as shown in the following figure. (This is the setting in the factory default configuration.)



* You can set the maximum flow rate, HV, to a value that exceeds the pump's capability, but the actual flow rate will not exceed the maximum flow rate of the pump.
(You can use this in situations such as when you want to perform full range flow rate control with input changes from 0 to 50%.)

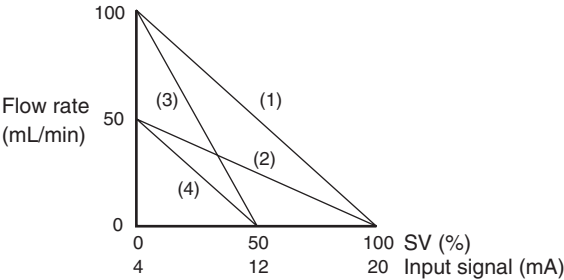
(Example) When the target value, SV, is set to 0 and the maximum flow rate, HV, is set to 200 on the QI-100



Analog-input proportional operation (QI only)

■Example 2: Input proportional operation with negative polarity (4 to 20mADC)

If [P5-1] is set to [1] in the "Parameter settings" (page 51), the result is a proportion graph in which the lines fall to the right (negative proportion) as shown in the following figure.



Parameter	Setting value	
P5-1	1 (20-4)	
	SV (%)	HV (mL/min)
(1)	100	100
(2)	100	50
(3)	50	100
(4)	50	50

Analog-input proportional operation (QI only)

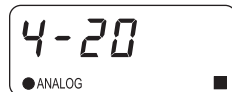
Operating procedure

NOTE

- For details on the settings, see "Setting examples" (page 36).

- (1) Press the "MODE" key until the "ANALOG" lamp lights.

The pump switches to analog-input proportional operation mode.



- (2) Press the "SET" key.



- (3) Use the arrow keys to set the target value, SV.

< > : Select the digit. ^ v : Increase/decrease the value.
Settable range: 0 to 100 (%)



- (4) Press the "SET" key.

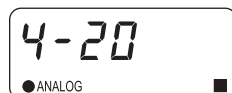


- (5) Use the arrow keys to set the maximum flow rate, HV.

< > : Select the digit. ^ v : Increase/decrease the value.
Settable range: 0.1 to 999.9 (mL/min)



- (6) Press the "SET" key to finish configuring the settings.



- (7) Press the "START/STOP" key to start operation.

The liquid is transferred at a flow rate that matches the applied signal.

* If error code "E-05" is displayed, the signal has not been applied correctly. Check the wiring.



- (8) Press the "START/STOP" key to stop operation.



Pulse-input proportional operation (QI only)

You can have the pump operate automatically according to an externally applied pulse signal.

Setting examples

You can use the combination of the "discharge volume per pulse" and the "flow rate" to configure a variety of settings.

■Meaning of terms

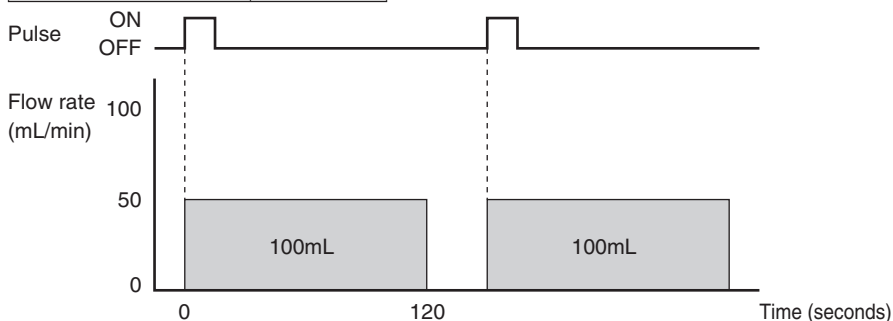
Discharge volume per pulse: The volume of liquid discharged by the pump in response to a single pulse signal

Flow rate: The flow rate when discharging the volume of liquid per pulse (the discharge speed)

■Example 1

Setting item	Setting value
Discharge volume per pulse	100mL
Flow rate	50mL/min

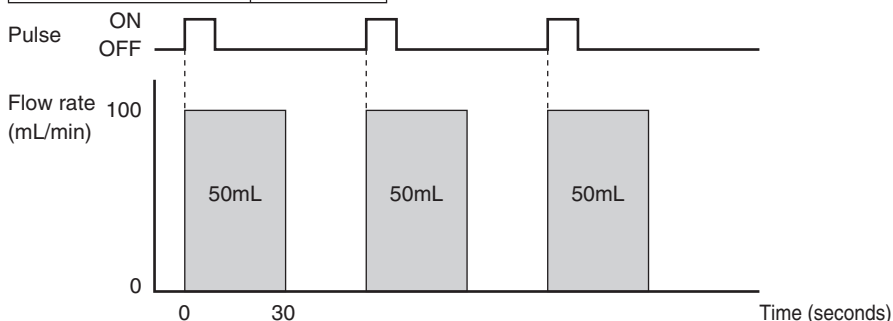
* 100mL of chemicals are discharged at a flow rate (discharge speed) of 50mL/min for each pulse signal.
(The operation time for one pulse is 2 minutes [120 seconds].)



■Example 2

Setting item	Setting value
Discharge volume per pulse	50mL
Flow rate	100mL/min

* 50mL of chemicals are discharged at a flow rate (discharge speed) of 100mL/min for each pulse signal.
(The operation time for one pulse is 0.5 minutes [30 seconds].)



Pulse-input proportional operation (QI only)

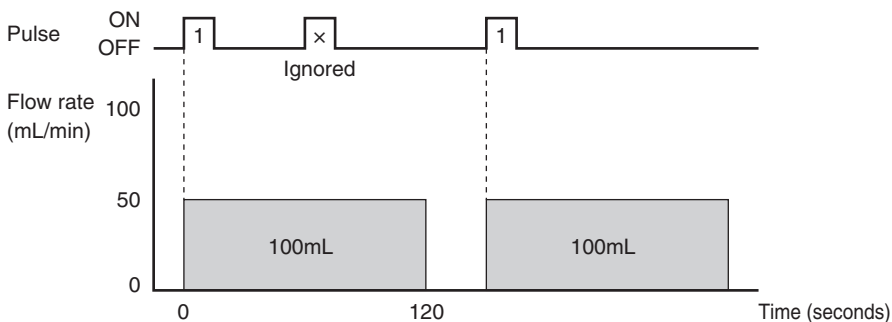
Behavior when a pulse signal is applied during pump operation

■Example 1

If [P6-2] is set to [1] in "Parameter settings" (page 51), pulse signals applied during pump operation will be ignored. (This is the setting in the factory default configuration.)

Setting item	Setting value
Discharge volume per pulse	100mL
Flow rate	50mL/min

Parameter	Setting value
P6-2	1

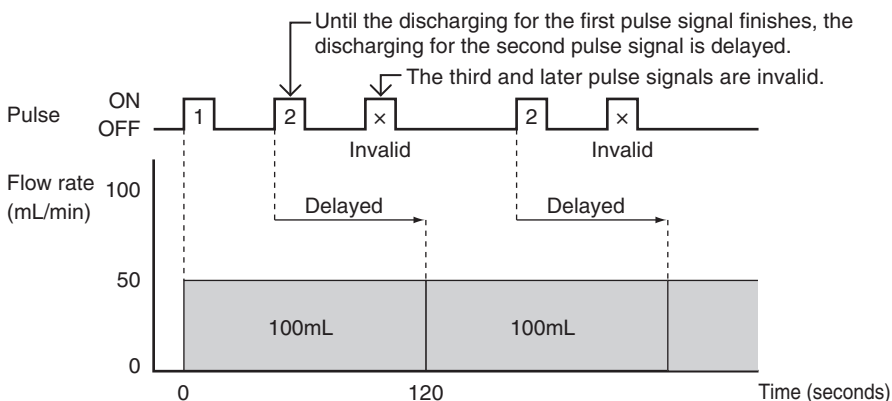


■Example 2

You can delay the pump from discharging liquid for the set number of pulse signals by setting [P6-2] to [2] or higher in "Parameter settings" (page 51).

Setting item	Setting value
Discharge volume per pulse	100mL
Flow rate	50mL/min

Parameter	Setting value
P6-2	2



* You can output an alarm signal when a pulse signal that exceeds the upper limit of the number of pulse signals to delay is applied by setting [P4-3] to [1] in "Parameter settings" (page 51).

Pulse-input proportional operation (QI only)

Operating procedure

NOTE

- For details on the settings, see "Setting examples" (page 39).

- (1) Press the "MODE" key until the "PULSE" lamp lights.

The pump switches to pulse-input proportional operation mode.



- (2) Press the "SET" key.



- (3) Use the arrow keys to set the discharge volume per pulse.

< > : Select the digit. ^ v : Increase/decrease the value.

Settable range: 0.1 to 999.9 (mL/pulse, L/pulse)

* In the factory default configuration, the setting is mL/pulse.

You can change this to L/pulse in "Parameter settings" (page 51).



- (4) Press the "SET" key.



- (5) Use the arrow keys to set the flow rate.

< > : Select the digit. ^ v : Increase/decrease the value.

Settable range: 0.1 to maximum flow rate (mL/min)



- (6) Press the "SET" key to finish configuring the settings.



- (7) Press the "START/STOP" key to start operation.

The pump operates according to the pulse signal.



- (8) Press the "START/STOP" key to stop operation.



Interval operation (QT only)

You can repeatedly start (ON) and stop (OFF) the pump's operation at fixed intervals.

Setting examples

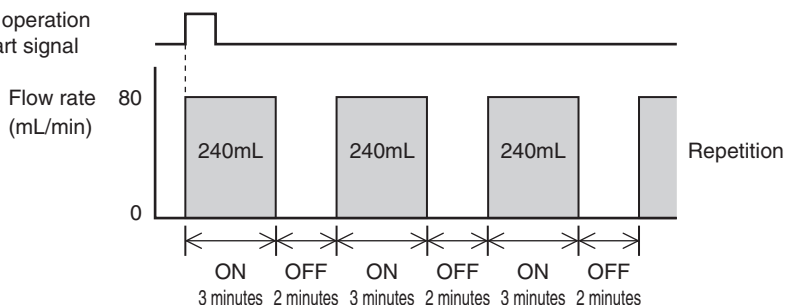
■Example 1

You can set the "ON time," "flow rate," and "OFF time."

Setting item	Setting value
ON time	3min
Flow rate	80mL/min
OFF time	2min

Parameter	Setting value
P7-3	1 (ON start)
P7-4	0 (no setting for the cycle count)

Start operation
or start signal



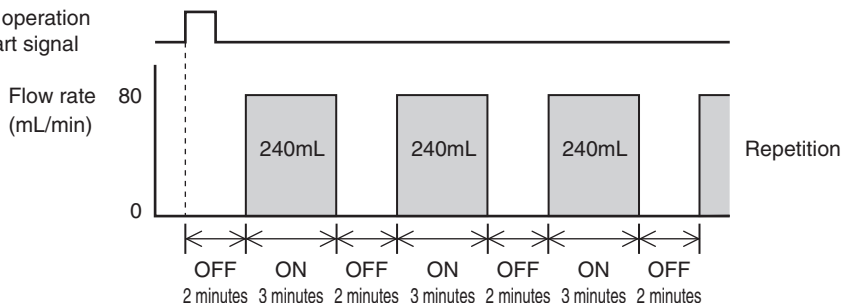
■Example 2

You can start from the OFF time in accordance with the start signal by setting [P7-3] to [0] in "Parameter settings" (page 52).

Setting item	Setting value
ON time	3min
Flow rate	80mL/min
OFF time	2min

Parameter	Setting value
P7-3	0 (OFF start)
P7-4	0 (no setting for the cycle count)

Start operation
or start signal



Interval operation (QT only)

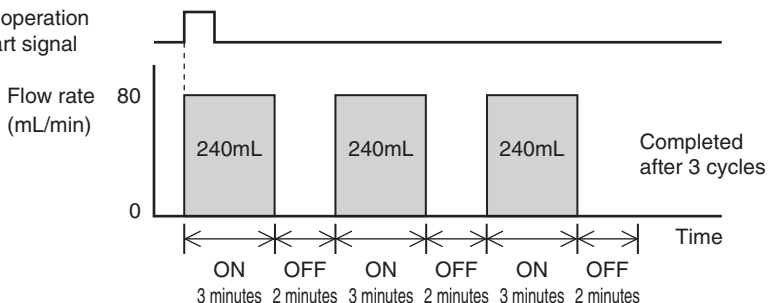
■Example 3

You can enable the setting of the repetition cycle count by setting [P7-4] to [1] in the "Parameter settings" (page 52).

Setting item	Setting value
ON time	3min
Flow rate	80mL/min
OFF time	2min
Cycle count	3

Parameter	Setting value
P7-3	1 (ON start)
P7-4	1 (setting present for the cycle count)

Start operation
or start signal



Setting examples

NOTE

- In the factory default configuration, the time setting unit is minutes (min). If you want to set the value in units of seconds (sec), change [P7-2] to [0] in the "Parameter settings" (page 52).
- For details on the settings, see "Setting examples" (page 42).

(1) Press the "MODE" key until the "INTVL" lamp lights.

The pump switches to interval operation mode.



(2) Press the "SET" key.



(3) Use the arrow keys to set the ON time.

< > : Select the digit. ^ v : Increase/decrease the value.

Settable range: 1 to 9999 (min, sec)



Interval operation (QT only)

(4) Press the "SET" key.



(5) Use the arrow keys to set the flow rate.

< > : Select the digit. ^ v : Increase/decrease the value.
Settable range: 0.1 to maximum flow rate (mL/min)



(6) Press the "SET" key.



(7) Use the arrow keys to set the OFF time.

< > : Select the digit. ^ v : Increase/decrease the value.
Settable range: 1 to 9999 (min, sec)



(8) Only when [P7-4] has been set to [1] in the "Parameter settings" (page 52)

Press the "SET" key.

Use the arrow keys to set the cycle count.

< > : Select the digit. ^ v : Increase/decrease the value.
Settable range: 1 to 9999 (cycles)



(9) Press the "SET" key to finish configuring the settings.



(10) Press the "START/STOP" key to start operation.

* You can also use external input to provide the start instruction.

See "Parameter settings" (pages 52 and 53).



(11) Press the "START/STOP" key to stop operation.



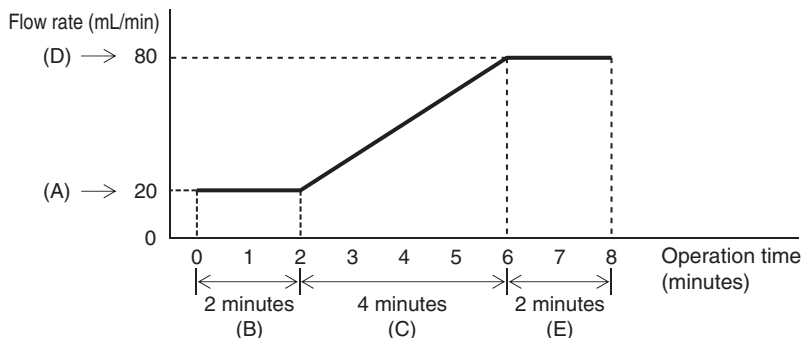
Gradient operation (QT only)

You can gradually increase or decrease the flow rate proportional to the passage of the pump's operation time.

Setting examples

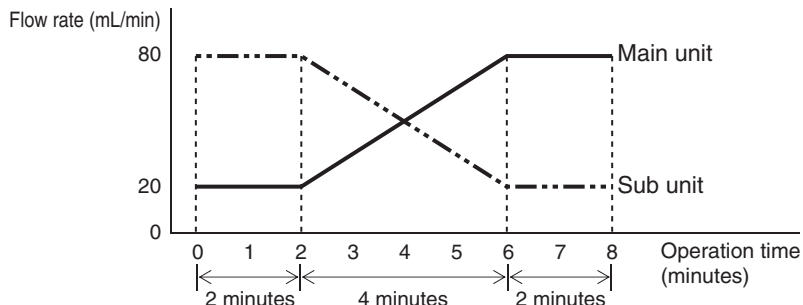
●Example 1: Operation with one pump

Setting item	Setting value	
Initial flow rate	20mL/min	... (A)
Initial retention time	2min	... (B)
Gradient time	4min	... (C)
Final flow rate	80mL/min	... (D)
Final retention time	2min	... (E)



●Example 2: Linked operation with two pumps

Setting item	Setting value (main unit)	Setting value (sub unit)
Initial flow rate	20mL/min	80mL/min
Initial retention time	2min	2min
Gradient time	4min	4min
Final flow rate	80mL/min	20mL/min
Final retention time	2min	2min



Gradient operation (QT only)

Operating procedure

NOTE

- In the factory default configuration, the time setting unit is minutes (min). If you want to set the value in units of seconds (sec), change [P7-2] to [0] in the "Parameter settings" (page 52).
- For details on the settings, see "Setting examples" (page 45).

- (1) Press the "MODE" key until the "GRAD" lamp lights.
The pump switches to gradient operation mode.



- (2) Press the "SET" key.



- (3) Use the arrow keys to set the initial flow rate.

< > : Select the digit. ^ v : Increase/decrease the value.
Settable range: 0.0 to maximum flow rate (mL/min)



- (4) Press the "SET" key.



- (5) Use the arrow keys to set the initial retention time.

< > : Select the digit. ^ v : Increase/decrease the value.
Settable range: 1 to 9999 (min, sec)



- (6) Press the "SET" key.



- (7) Use the arrow keys to set the gradient time.

< > : Select the digit. ^ v : Increase/decrease the value.
Settable range: 1 to 9999 (min, sec)



- (8) Press the "SET" key.



- (9) Use the arrow keys to set the final flow rate.

< > : Select the digit. ^ v : Increase/decrease the value.
Settable range: 0.0 to maximum flow rate (mL/min)



- (10) Press the "SET" key.



Gradient operation (QT only)

(11) Use the arrow keys to set the final retention time.

< > : Select the digit. ^ v : Increase/decrease the value.
Settable range: 1 to 9999 (min, sec)



(12) Press the "SET" key to finish configuring the settings.



(13) Press the "START/STOP" key to start operation.

* You can also use external input to provide the start instruction.

See "Parameter settings" (pages 52 and 53).



(14) Press the "START/STOP" key to stop operation.



Linking together multiple pumps

You can perform gradient operation with multiple instances of this pump linked together. This enables you to do things such as performing tests in which multiple liquids are continuously mixed together while the proportions of the different liquids are changed over time.

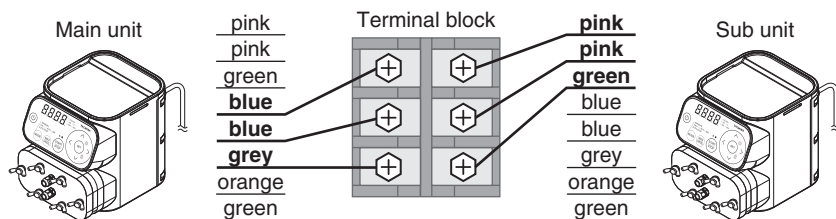
●Operation mechanism

Among the pumps to be linked together, set one pump as the "main unit" and all others as "sub units."

You can synchronize the operations of the pumps by applying to the sub units the GRAD start signal and the clock signal output from the main unit.

(1) Connect the signal cables between the main unit and the sub unit.

1. Connect the main unit's "digital output 1 (blue)" to the sub unit's "digital input 1 (pink)."
2. Connect the main unit's "digital output 2 (blue)" to the sub unit's "digital input 2 (pink)."
3. Connect the main unit's "digital output common (pink)" to the sub unit's "digital input common (green)."



* For details on the roles of each wire see "Connecting the signal cable" (page 23).

Gradient operation (QT only)

(2) Set the main unit and sub unit parameters.

Follow the procedure in "Parameter settings" (page 52) to change the setting of [P7-6] for both the main unit and the sub unit. Set this parameter to [1] on the main unit and to [2] on the sub unit.

Parameter	Function	Main unit setting	Sub unit setting
P7-6	Main unit/sub unit selection	1	2

The pump indicates the main unit/sub unit selection by lighting the "MAIN" (main unit) or "SUB" (sub unit) lamp.

(3) Set the gradient operation on the main unit and sub unit.

* For details, see "Setting examples" (page 45) and "Operating procedure" (page 46).

(4) Press the "START/STOP" key on the main unit to start operation.

Operation starts on the main unit and sub unit at the same time.

The pumps will perform the set operations and then stop automatically.

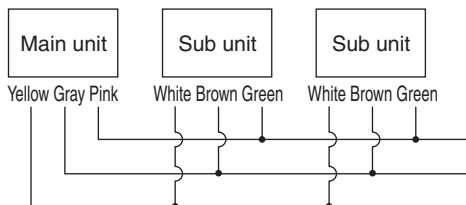
- * You can also use external input to provide the start instruction. See "Parameter settings" (pages 52 and 53).
- * To stop operation before it is stopped automatically, press the "START/STOP" key on the main unit. When you stop the main unit, the sub unit will also stop. (Operations of the "START/STOP" key on the sub unit are invalid.)
- * During linked operation between a main unit and sub units, all the pumps stop completely when a pause signal is applied to the main unit. Operation does not start again even if the signal is cleared.



Main unit

NOTE

- You can connect up to four sub units to a single main unit. For details on connecting five or more sub units, contact your vendor or TACMINA.
- If you are using multiple sub units, wire them in parallel as shown in the following figure.



Key lock

This function disables the key operations that are used to perform tasks such as changing the mode and changing settings.

You can use this to prevent misuse and tampering.

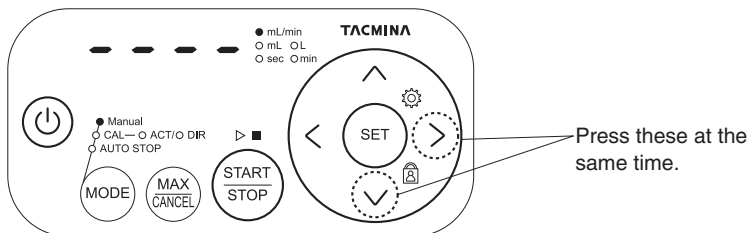
● Even when the key lock is enabled, the following operations are possible.

- Turning the power on/off
- Starting/stopping the pump
- Operating the pump at the maximum flow rate

(1) With the pump stopped, press the " √ " and " > " arrow keys at the same time for 1 second or more.

This enables the key lock.

With the key lock enabled, if you press one of the disabled keys, "- - -" is displayed.



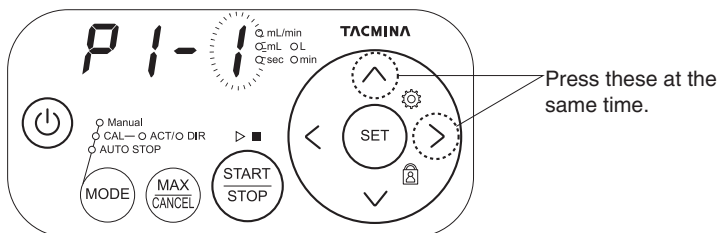
(2) Once more, press the " √ " and " > " arrow keys at the same time for 1 second or more.

This disables the key lock.

Parameter settings

You can configure the settings related to pump operation.

- (1) With the pump stopped in manual operation mode, press the " $\wedge$ " and " $\succ$ " arrow keys at the same time for 1 second or more.



- (2) Use the arrow keys to display the number of the parameter that you want to change.

$\wedge$ $\succ$: Select the parameter digit.

$\wedge$ $\vee$: Increase/decrease the parameter number.

- (3) After you have displayed the number of the parameter that you want to change, press the "SET" key.

- (4) Use the $\wedge$ or $\vee$ arrow key to change the setting value.

- (5) Press the "SET" key.

- (6) Press the "MODE" key to return to the previous screen.

Parameter list (Q: standard type)

	Parameter	Function	Setting value * Default values are shown in bold.
Basic settings*1	P1-1	Status of the pump power supply when the main power supply turns on	0: Off 1: On
	P1-2	Pump operation status when the main power supply turns on	0: Stopped 1: Maintained
	P1-3	Number of displayed flow rate digits in manual operation mode	0: One decimal position 1: Two decimal positions
Auto-stop	P7-1	Auto-stop operation unit setting	0: sec 1: min 2: mL 3: L
Initialization*2	P8-1	Initialization (resets the pump to the factory default configuration)	0: Do not initialize 1: Initialize

*1 [P1-3] cannot be set for Q□-500 models.

*2 On the Q-60/30/10, the maximum flow rate will be displayed as 100 ml/min after initialization is performed. However, this differs from the actual maximum discharge volume, so be sure to perform calibration (for which the information starts on page 29).

Parameter settings

Parameter list (QI: input signal control model)

	Parameter	Function	Setting value * Default values are shown in bold.
Basic settings*1	P1-1	Status of the pump power supply when the main power supply turns on	0: OFF 1: ON
	P1-2	Pump operation status when the main power supply turns on	0: Stopped 1: Maintained
	P1-3	Number of displayed flow rate digits in manual operation mode	0: One decimal position 1: Two decimal positions
input	P2-1	Digital input 1 assignment *2 (See page 53.)	0: None 1: Pulse 2: – 3: Pause/Run 4: Level 5: MAX operation
	P2-2	Digital input 2 assignment *2 (See page 53.)	0: None 1: Pulse 2: – 3: Pause/Run 4: Level 5: MAX operation
	P2-3	Operation when a pause/run signal is applied	0: Pause 1: Run
Output	P3-1	Digital output 1 assignment (See page 53.)	0: None 1: Unit pulse 2: – 3: Alarm 4: Operation signal
	P3-2	Digital output 2 assignment (See page 53.)	0: None 1: Unit pulse 2: – 3: Alarm 4: Operation signal
	P3-3	Pulse output unit amount	0: 0.1mL*3 1: 1mL 2: 10mL 3: 100mL
Alarms	P4-1	Level error	0: Disable 1: Enable
	P4-2	Analog input error	1: Enable (This cannot be changed.)
	P4-3	Pulse overflow error	0: Disable 1: Enable
Analog input	P5-1	Analog input type	0: 4-20 1: 20-4
Digital input	P6-1	Input filter (Assigned to both DI1 and DI2.)	5 to 40 (milliseconds)
	P6-2	Number of pulses to delay	1 to 30 (pulses)
	P6-3	Pulse input setting unit	0: mL/pulse 1: L/pulse
	P6-4	Digital input 1 check	0: Open 1: Closed
	P6-5	Digital input 2 check	0: Open 1: Closed
Initialization*4	P8-1	Initialization (resets the pump to the factory default configuration)	0: Do not initialize 1: Initialize

*1 [P1-3] cannot be set for Q□-500 models.

*2 You cannot select the same setting value for [P2-1] and [P2-2].

*3 If you set the pulse output unit amount to 0.1mL, use the pump with a flow rate of 60mL/min or less. If you use the pump with a flow rate greater than 60mL/min, the equipment receiving the signals may not be able to recognize the pulses correctly.

*4 On the QI-60/30/10, the maximum flow rate will be displayed as 100 ml/min after initialization is performed. However, this differs from the actual maximum discharge volume, so be sure to perform calibration (for which the information starts on page 29).

Parameter settings

Parameter list (QT: timer control type)

	Parameter	Function	Setting value * Default values are shown in bold.
Basic settings*1	P1-1	Status of the pump power supply when the main power supply turns on	0: OFF 1: ON
	P1-2	Pump operation status when the main power supply turns on	0: Stopped 1: Maintained
	P1-3	Number of displayed flow rate digits in manual operation mode	0: One decimal position 1: Two decimal positions
Input	P2-1	Digital input 1 assignment *2 *4 (See page 53.)	0: None 1: – 2: Start 3: Pause/Run 4: Level 5: MAX operation
	P2-2	Digital input 2 assignment *2 *4 (See page 53.)	0: None 1: – 2: Start 3: Pause/Run 4: Level 5: MAX operation
	P2-3	Operation when a pause/run signal is applied	0: Pause 1: Run
Output	P3-1	Digital output 1 assignment *3 (See page 53.)	0: None 1: Unit pulse 2: End signal 3: Alarm 4: Operation signal
	P3-2	Digital output 2 assignment *3 (See page 53.)	0: None 1: Unit pulse 2: End signal 3: Alarm 4: Operation signal
	P3-3	Pulse output unit amount	0: 0.1mL*5 1: 1mL 2: 10mL 3: 100mL
Alarms	P4-1	Level error	0: Disable 1: Enable
Digital input	P6-1	Input filter (Assigned to both DI1 and DI2.)	5 to 40 (milliseconds)
	P6-4	Digital input 1 check	0: Open 1: Closed
	P6-5	Digital input 2 check	0: Open 1: Closed
Timer	P7-2	Timer time unit for interval operation and gradient operation	0: sec 1: min
	P7-3	Interval operation starting status	0: Start OFF 1: Start ON
	P7-4	Interval operation cycle count	0: OFF 1: ON
	P7-5	Start instruction for interval operation and gradient operation	0: "START/STOP" key 1: External input*6
	P7-6	Main unit/sub unit selection for gradient operation	0: None (when using one unit) 1: Main unit*3 2: Sub unit*4
Initialization*7	P8-1	Initialization (resets the pump to the factory default configuration)	0: Do not initialize 1: Initialize

*1 [P1-3] cannot be set for Q□-500 models.

*2 You cannot select the same setting value for [P2-1] and [P2-2].

*3 When [P7-6] is set to [1], digital output 1 will be used for the clock output and digital output 2 will be used for the GRAD start output regardless of the settings of [P3-1] and [P3-2].

*4 When [P7-6] is set to [2], digital input 1 will be used for the clock input and digital input 2 will be used for the GRAD start input regardless of the settings of [P2-1] and [P2-2].

*5 If you set the pulse output unit amount to 0.1mL, use the pump with a flow rate of 60mL/min or less. If you use the pump with a flow rate greater than 60mL/min, the equipment receiving the signals may not be able to recognize the pulses correctly.

*6 You have to set [P2-1] or [P2-2] to [2].

*7 On the QT-60/30/10, the maximum flow rate will be displayed as 100 ml/min after initialization is performed. However, this differs from the actual maximum discharge volume, so be sure to perform calibration (for which the information starts on page 29).

Parameter settings

Digital input/output assignments (QI and QT only)

●Digital input 1 (parameter P2-1)/ digital input 2 (parameter P2-2)

Setting value	Assignment	Explanation
1	Pulse (QI only)	This is used in pulse-input proportional operation (page 39).
2	Start (QT only)	Use this when you want to use external trigger input to provide the start instruction for interval operation or gradient operation. * You have to set parameter [P7-5] to [1].
3	Pause/Run	The pump will pause or run only while the external signal is applied. * You can use parameter [P2-3] to set whether the pump pauses or runs while the signal is applied. * When a pause signal is applied during interval operation or gradient operation, the remaining time is maintained and the pump runs again for this remaining time when the signal is cleared. However, during linked operation between a main unit and sub units, all the units stop completely when a pause signal is applied to the main unit and operation does not start again even if the signal is cleared. * When a pause signal is applied during pulse-input proportional operation, all the pending pulses will be canceled.
4	Level	This is linked to the level switch and is used to detect the amount of liquid remaining in the tank.
5	MAX operation	This is used in place of the "MAX/CANCEL" key. The pump will be operated with the maximum flow rate only while the external signal is applied.

●Digital output 1 (parameter P3-1)/ digital output 2 (parameter P3-2)

Setting value	Assignment	Explanation
1	Unit pulse	Each time that a fixed unit is discharged,*1 a pulse signal (50msec) is output. You can set the unit amount with parameter [P3-3]. (The setting is 1mL in the factory default configuration.)
2	End signal (QT only)	During interval or gradient operation, a pulse signal (100msec) is output when the set operations finish.
3	Alarm	A signal is continuously output when a level error, analog input error (QI only), or pulse overflow error (QI only) occurs. * For details on the alarms, see page 69. * For level errors and pulse overflow, you can use parameters [P4-1] and [P4-3], respectively, to enable or disable the alarm output. The alarm output is always enabled for analog input errors.
4	Operation signal	This signal is continuously output during pump operation (while the motor is operating).

*1 This operation is based on the calculated value. The calculated value may vary from the amount that is actually discharged.

Disassembling the liquid-end section



WARNING

- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Before disassembling the liquid-end section, be sure to turn off the power and check that no voltage is being applied to the pump. Do not disassemble this section after simply using the key to stop the pump. Hang a sign on the power switch indicating that work is in progress so as to prevent the power from being turned on again during the course of work.
- When working on the liquid-end section of the pump, be sure to wear protective gear (such as rubber gloves, a mask, protective goggles, and work clothes that are resistant to chemicals) suited to the chemical concerned.
- Before performing maintenance or repairs on the pump, release the pressure out of the discharge pipe, drain the liquid from the liquid end part and replace with a proper liquid, then flush with water. After flushing with water, remove the pipes and drain the residual liquid remaining in the pump head by either drawing it out with a syringe from the discharge side or operating the pump after removing the suction pipe.

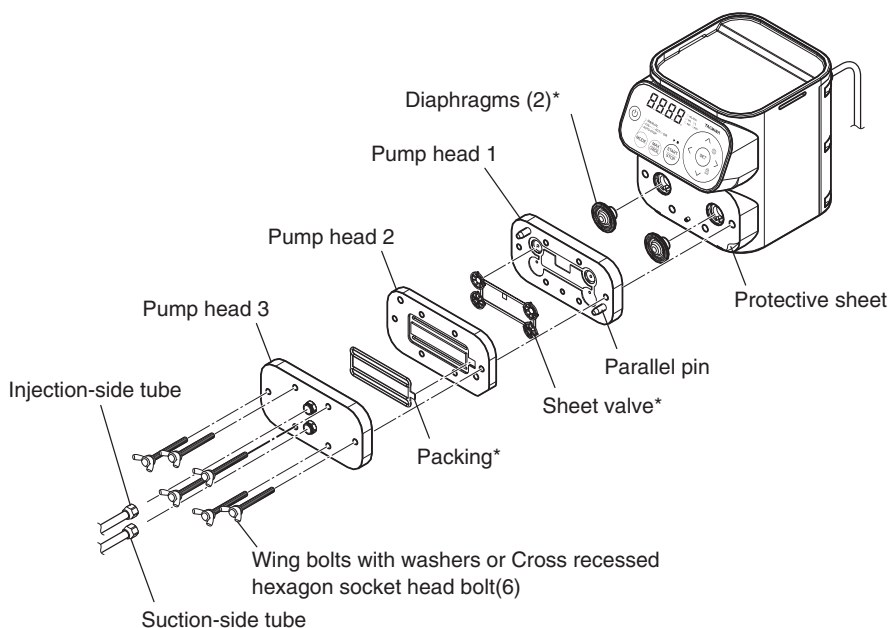
IMPORTANT

- When a pump is used to transfer a liquid that reacts with water to produce heat (concentrated sulfuric acid, concentrated hydrochloric acid, thionyl chloride, etc.), perform primary cleaning with methanol or other liquids first. Cleaning immediately with water first may deform the sheet valves or packing due to the heat of the reaction.

Disassembling the liquid-end section

Q/QI/QT-500 / 100 / 60 / 30

- (1) Remove the tubes from the suction-side and discharge-side joints.
- (2) Turn the wing bolts with washers (Q/QI/QT-100/60) or the Cross recessed hexagon socket head bolt (Q/QI/QT-500/30) to remove them.
- (3) Remove the pump heads.
- (4) Pull the diaphragms out of the pump.
The diaphragms are magnet types, so you only have to pull on them firmly to remove them from the pump.
* Using a tool to pull on the diaphragms may damage them. Remove them by hand.



The parts indicated with an asterisk (*) are consumables, so replace them periodically. (See "Consumables list" on page 72.)

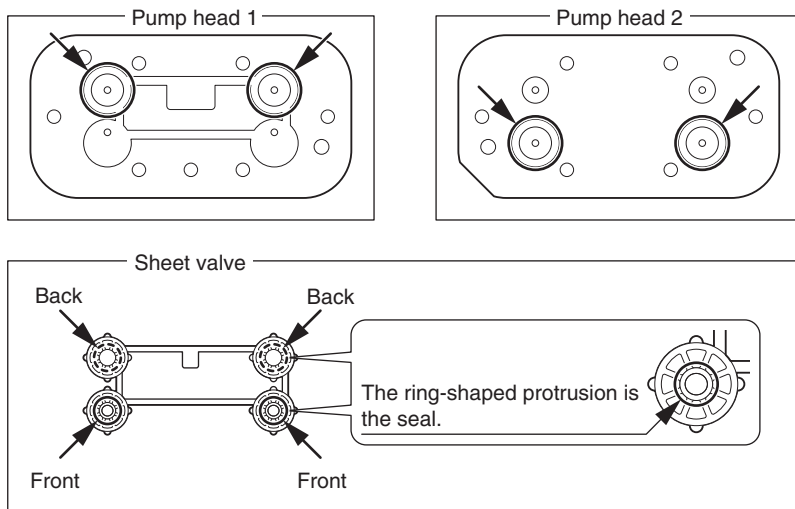
Disassembling the liquid-end section

(5) Inspect the parts.

(1) Pump heads, sheet valve, and packing

Check for damage and for the adherence of foreign material. Exercise special care when checking the seals of the pump heads and the sheet valve (see the following figures).

Remove any foreign material that has adhered to the parts.



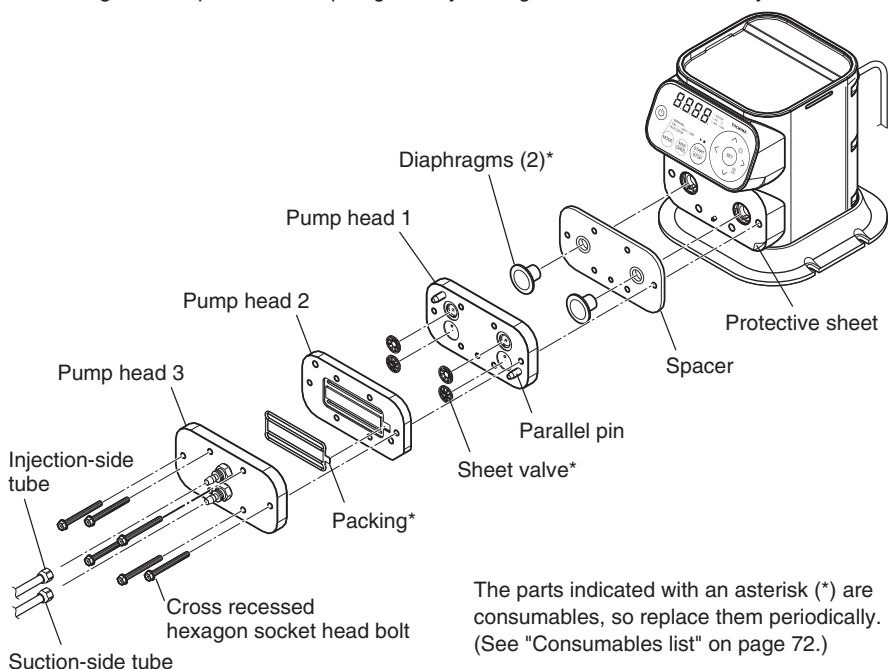
(2) Protective sheet

Check that there is no rust or damage on the protective sheet affixed to the surface where the pump body and the pump head come into contact with each other (the body side). If there is rust or damage on the protective sheet, replace it with a new one.

Disassembling the liquid-end section

Q/QI/QT-10

- (1) Remove the tubes from the suction-side and discharge-side joints.
- (2) Turn the cross recessed the Cross recessed hexagon socket head bolt to remove them.
- (3) Remove the pump heads.
- (4) Pull the diaphragms out of the pump.
The diaphragms are magnet types, so you only have to pull on them firmly to remove them from the pump.
* Using a tool to pull on the diaphragms may damage them. Remove them by hand.



NOTE

- When you remove the pump from its stand for storage, remove the pump heads to prevent the pump from falling over.

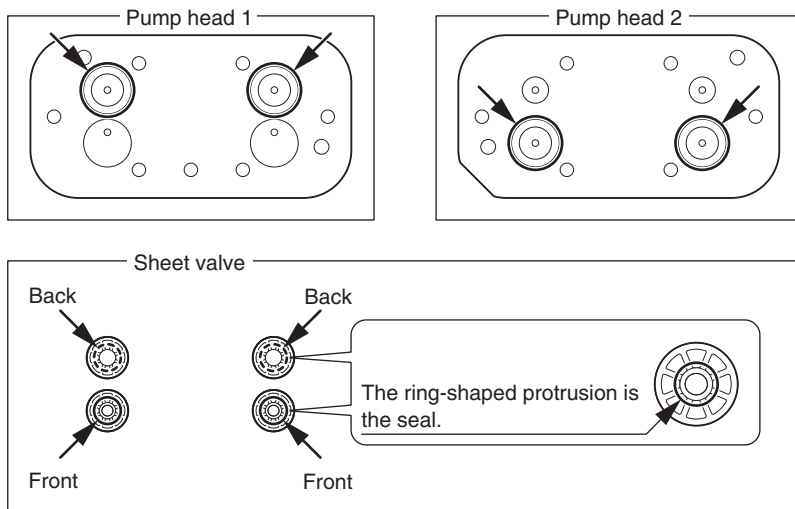
Disassembling the liquid-end section

(5) Inspect the parts.

(1) Pump heads, sheet valve, and packing

Check for damage and for the adherence of foreign material. Exercise special care when checking the seals of the pump heads and the sheet valve (see the following figures).

Remove any foreign material that has adhered to the parts.



(2) Protective sheet

Check that there is no rust or damage on the protective sheet affixed to the surface where the pump body and the pump head come into contact with each other (the body side). If there is rust or damage on the protective sheet, replace it with a new one.

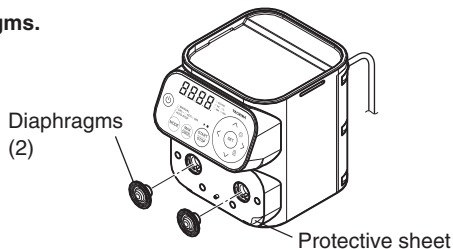
Assembling the liquid-end section

Q/QI/QT-500 / 100 / 60 / 30

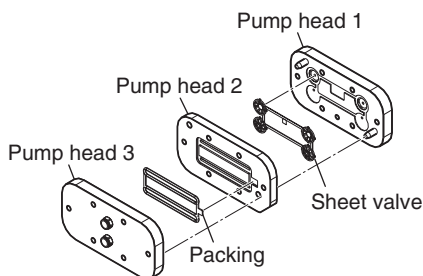
(1) Check whether chemicals have affixed to the protective sheet.

Chemicals affixing to the protective sheet may cause it to rust, so wipe the protective sheet clean.

(2) Attach the diaphragms.



(3) Assemble the pump head.

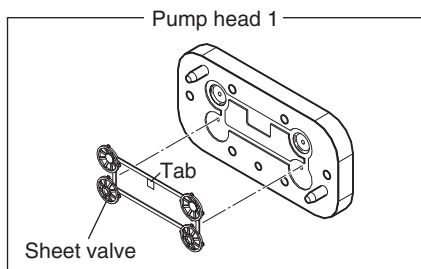


* A character that indicates the material of the sheet valve or packing is inscribed on the tab of each of these parts.

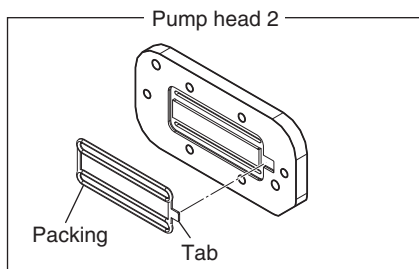
E: EPDM

F: Special fluoro rubber

T: Special fluoro rubber (perfluoro)



Align the sheet valve with the grooves on the pump head.
(If the parts do not match, their orientations are incorrect.)



Align the packing with the grooves on the pump head.
(Both sides of the packing can be used for its front and back.)

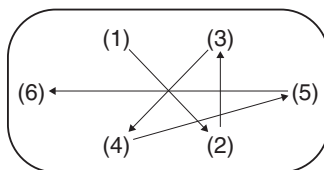
IMPORTANT

- Check that the sheet valve and the packing fit tightly in the grooves on the pump head. Attaching these parts incorrectly may result in discharge defects or leaking fluid.

Assembling the liquid-end section

IMPORTANT

- When securing the pump head with bolts, tighten evenly a little at a time in the order shown in the figure on the right. For example, if bolts are tightened in the order of (1), (3), (5), and (2) and not tightened evenly, liquid may leak from the pump head.

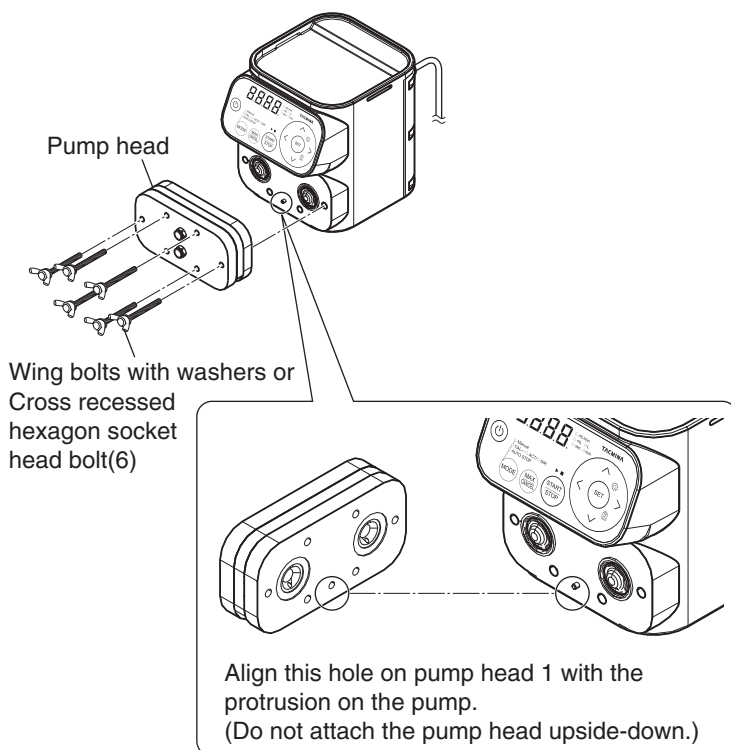


- (4) Attach the pump head that you assembled in step (3), and then use the wing bolts with washers (Q/QI/QT-100/60) or the Cross recessed hexagon socket head bolt (Q/QI/QT-500/30) to fix it in place.**

Cross recessed self-tapping screw tightening torque = 2.0 N·m

* Do not use a wrench to tighten these parts.

Tightening them with excessive force may lead to damage.



- (5) Connect the suction-side and discharge-side tubes.**

See "Connecting tubes" on page 19.

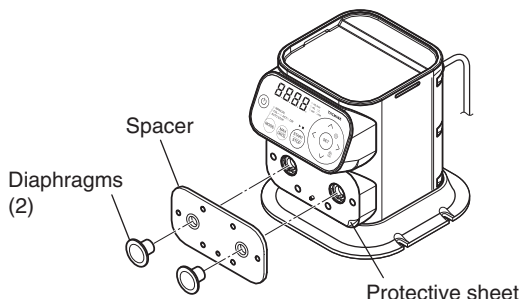
Assembling the liquid-end section

Q/QI/QT-10

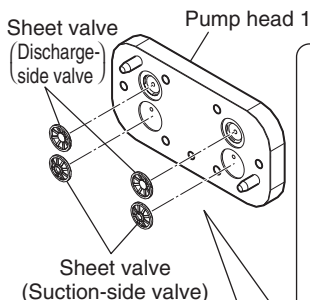
(1) Check whether chemicals have affixed to the protective sheet.

Chemicals affixing to the protective sheet may cause it to rust, so wipe the protective sheet clean.

(2) Insert the diaphragms into the spacer, and then attach the spacer to the pump body.

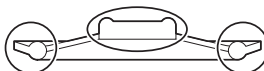


(3) Insert the sheet valve into pump head 1.



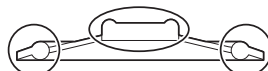
There are two types of sheet valves: the discharge-side valve and the suction-side valve.

Discharge-side valve



The edges along the outer circumference are bent in the same direction as the projection in the center.

Suction-side valve



The edges along the outer circumference are bent in the opposite direction as the projection in the center.

Discharge-side valve

Attach the valve so that the projection in the center and the edges along the outer circumference face pump head 1.

Suction-side valve

Attach the valve so that the projection in the center faces away from pump head 1.

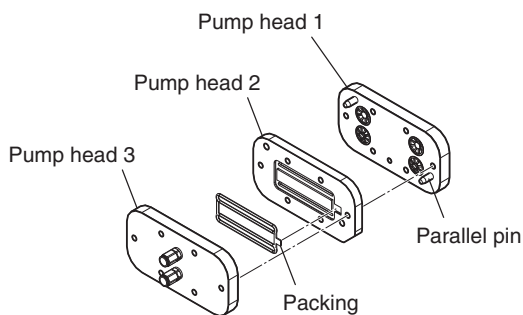
Pump head 1



Pump body

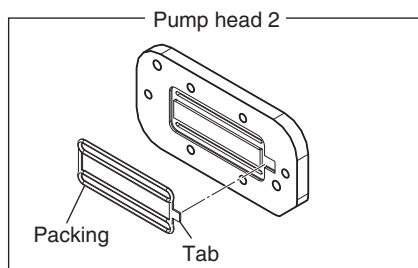
Assembling the liquid-end section

(4) Assemble the pump head.



* A character that indicates the material of the packing is inscribed on the tab of each of these parts.

T: Special fluoro rubber (perfluoro)



Align the packing with the grooves on the pump head.
(Both sides of the packing can be used for its front and back.)

IMPORTANT

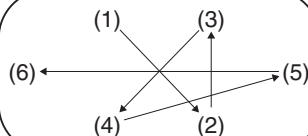
- Check that the sheet valve and the packing fit tightly in the grooves on the pump head. Attaching these parts incorrectly may result in discharge defects or leaking fluid.

Assembling the liquid-end section

- (5) Attach the pump head that you assembled in step (4), and then insert the cross recessed self-tapping screws.

IMPORTANT

- When securing the pump head with bolts, tighten evenly a little at a time in the order shown in the figure on the right. For example, if bolts are tightened in the order of (1), (3), (5), and (2) and not tightened evenly, liquid may leak from the pump head.

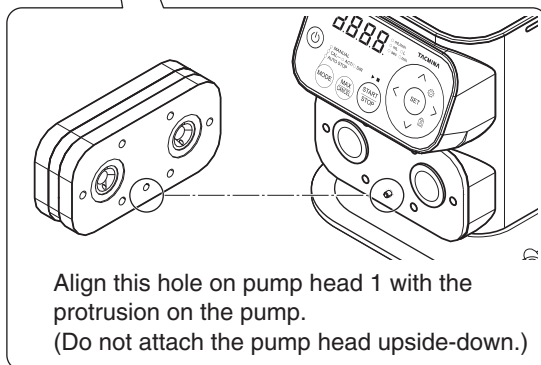
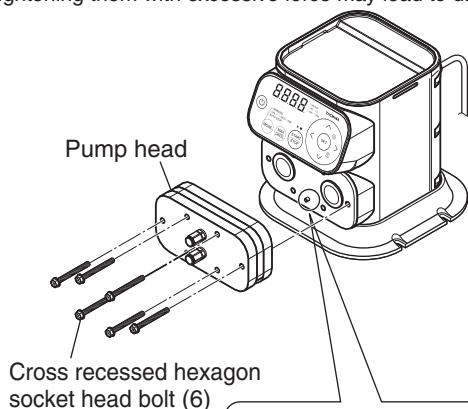


- (6) Use a Phillips head screwdriver to tighten the cross recessed self-tapping screws.

Cross recessed self-tapping screw tightening torque = 2.0 N·m

* Do not use a wrench to tighten these parts.

Tightening them with excessive force may lead to damage.



- (7) Connect the suction-side and discharge-side tubes.

See "Connecting tubes" on page 19.

Correcting motor step-out

If the pressure on the discharge side of the pump increases abnormally due to clogging of the tubes, valve shutoff, or some other reasons, motor step-out (idle-like status) will occur in order to prevent damage to the pump and tubes. When motor step-out occurs, a vibration noise can be heard. Perform the following procedure to rectify the situation.

(1) Stop the pump.

(2) Eliminate the cause of abnormal pressure.

If a valve is closed on the discharge side, open it.

If piping is clogged, clean it.

(3) Disassemble the pump head and check for abnormalities in the liquid-end section.

See “Disassembling the liquid-end section” on pages 54 to 58.

Remove any foreign material that has adhered to any parts inside the pump head.

(4) Reassemble the pump head and attach it.

See “Assembling the liquid-end section” on pages 59 to 63.

Correctly install the sheet valve or packing in the appropriate position.

(5) Operate the pump and verify that rated volume of discharge is correct.

NOTE

- Following motor step-out, liquid transfer can be resumed once the pressure returns to the rated range. If operation is resumed before the pressure returns to the rated range, liquid leakage or discharge defects may occur due to sheet valve misalignment, etc.

Troubleshooting

Common to all models

Details	Cause	Remedy
The pump does not turn on. (The control panel does not light.)	The power supply or voltage is not correct.	Connect the pump to the correct power supply.
	The power cord is broken.	Contact your vendor or TACMINA.
	The source power supply has been interrupted.	Position the switch on the correct side.
	The breaker has tripped.	Investigate why the breaker has tripped, and then reset it.
The power turns on, but the pump does not operate.	The motor is malfunctioning.	Contact your vendor or TACMINA.
The pump does not operate at the maximum discharge pressure. (The drive sound registers weakly.)	The power supply or voltage is not correct.	Connect the pump to the correct power supply.

Troubleshooting

Details	Cause	Remedy
The pump operates, but the discharge volume is low or the liquid is not discharged or suctioned.	Calibration has not been performed correctly.	Perform calibration. (Performing calibration for a long time will improve the calibration accuracy.) * This pump has a reproducibility of $\pm 1\%$ (full scale ratio)
	Some condition has changed after calibration was performed.	Perform calibration again.
	Liquid viscosity is too high.	• Decrease the viscosity. • Increase the size of the suction-side piping to enable pressure booster piping. • Increase the discharge-side pipe diameter.
	The amount of liquid in the tank on the suction side is low.	Fill the tank with liquid, and then release the air.
	A clog is present in the piping or valves.	Clean the piping and valves.
	The foot valve or the strainer is clogged.	Clean the foot valve, strainer, and tank.
	Cavitation is occurring within the suction-side piping or pump head.	Make the suction-side piping larger or shorter.
	The suction height exceeds the specification range.	Set the suction height to a value within the specification range.
	Air has entered into the pump head.	• Release the air. • Eliminate the cause of the air entering into the pump head. (See the "Air enters into the pump" item.)
	Debris has affixed to the inside of the pump head or the sheet valve, or these parts are deformed.	• Clean the pump head or sheet valve or replace them. • If the sheet valve is deformed in a short period of time, use a sheet valve of a different material.
	The installation direction of the sheet valve is wrong.	Install the sheet valve correctly.
	The diaphragm has deteriorated or is damaged.	Replace the diaphragm.
	Liquid is leaking from the discharge-side piping.	Inspect the piping and retighten it.
	Relief valve activated.	Adjust the pressure setting.
	The discharge pressure is too high.	Decrease the pressure.

Troubleshooting

Details	Cause	Remedy
The discharge volume is too large.	Calibration has not been performed correctly.	Perform calibration. (Performing calibration for a long time will improve the calibration accuracy.) * This pump has a reproducibility of $\pm 1\%$ (full scale ratio)
	Some condition has changed after calibration was performed.	Perform calibration again.
	Overfeeding is occurring.	• Check whether the piping diameter and length is appropriate. • Use a valve such as a back pressure valve to apply back pressure. • Clean the back pressure valve.
	A negative pressure is occurring at the injection point.	• Use a valve such as a back pressure valve to apply back pressure. • Clean the back pressure valve.
	The push pressure is too high.	Set the discharge-side pressure to a value higher than the push pressure.
The liquid does not stop.	Siphoning is occurring.	Review the piping, install a vent pipe, or install a back pressure valve.
	Air remains in the piping or the damper effect is occurring.	Release the air in the piping.
Large pulsation occurs.	Debris has affixed to the pump head or the sheet valve, or these parts are deformed.	Clean the pump head or sheet valve or replace them.
Air enters into the pump.	Gas is being produced due to the nature of the liquid.	Eliminate the causes of gas production.
	The joints or seals are loose.	Retighten the joints or seals.
	The amount of liquid in the tank on the suction side is low.	Fill the tank with liquid, and then release the air.
Liquid is leaking from the joints.	The joints are not tightened sufficiently.	Retighten the joints.
	The discharge-side pipe is clogged with dirt or other foreign material, which has caused the pressure to increase.	Clean inside the pipe.
	Tubes have deteriorated.	Replace the tubes.

Troubleshooting

Details	Cause	Remedy
Liquid is leaking from the pump head.	The bolts are loose.	Retighten the bolts.
	The bolts have been tightened unevenly.	Tighten the bolts evenly.
	The discharge-side pipe is clogged with dirt or other foreign material, which has caused the pressure to increase.	Clean the pipe.
	The diaphragm is damaged.	Replace the diaphragm.
	The sheet valve or packing is misaligned or has deteriorated.	Install the sheet valve or packing correctly or replace it.
The keys cannot be operated.	The key lock has been enabled.	Release the key lock.
A vibration noise can be heard.	Motor step-out (a state similar to idling) has occurred due to an abnormal pressure .	See “Correcting motor step-out” on page 64.

QI and QT only

Details	Cause	Remedy
Control by way of digital input cannot be performed correctly.	The signal cable connections are incorrect.	Check the signal cable, and then connect it correctly.
	Noise is present on the signal cable.	- Remove the signal cable and the power cable. - Use a shielded cable for the signal cable.
	The signal cable is broken.	Replace the signal cable.
	The signal specifications are different.	Replace the device with one that matches the signal specifications.
	The pulse signal is chattering.	Replace the device with one that does not chatter.

QI only

Details	Cause	Remedy
Control by way of analog input cannot be performed correctly.	A current less than 20mA is flowing due to insufficient driving power in the analog signal.	Check the signal source's maximum drive resistance.

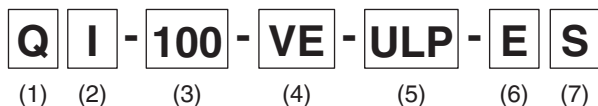
Error codes

If an error code appears on the display, use the error code list shown below to check the details of the error, and then implement the required remedy.

●Error code list

Code	Details	Cause	Remedy
E-02	Level error	The amount of liquid in the tank is incorrect. * This error is displayed when digital input 1 or digital input 2 is set to level input and the signal is ON.	Check the tank's liquid level and implement the required corrective measures.
E-04	Pulse overflow	During pulse-input proportional operation, the number of pulse signals applied has exceeded the set number of pulses to delay.	• Review the setting for the number of pulses to delay. (Parameter P6-2) • Check the device that is the source of the input.
E-05	Analog input error	During analog-input proportional operation, a signal outside of the prescribed range has been applied or no signal has been applied.	Check the wiring.
E-09	Calibration error	You stopped the pump within 30 seconds of starting operation.	Let the pump operate for 30 seconds or more. (2 minutes or more is recommended.)
		The entered value is outside the range over which calibration is possible. (This could be a measurement or entry mistake.)	Check the cause of the error, and then perform calibration again.

Model code



(1) Series name

Q Series

(2) Control method

Blank: Standard type

I: I/O signal control type

T: Timer control type

(3) Model (Flow rate standard)

500: 500mL/min

100: 100mL/min

60: 60mL/min

30: 30mL/min

10: 10mL/min

(4) Liquid-end section materials

	Pump head	Diaphragms	Sheet valve/Packing	Joint
VE	PVC	PTFE/CR	EPDM	PP
VF	PVC	PTFE/CR	FKM	PP
TT	PTFE	PTFE/CR	FFKM	PTFE/ECTFE
6T	SUS316	PTFE/CR	FFKM	SUS316

(5) Power cord

ULP: Type A

* Plug types O, C, BF are included.

Complies with UL Standards only when a Type A plug is used.

(6) Language

E: English

Blank: Japanese

(7) General specifications

S: Standard

X: Special order

* You cannot freely combine the aspects of the model code.

* An X at the end of a model code indicates a made-to-order product. For the detailed specifications, see the diagrams, approval documents, or similar materials. Also, joints may not be included in the accessories. Please prepare compatible joints on your own.

* A front plate (SUS) or a lower plate (SUS) may be attached to a pump in case of X specifications.

* For models ending in X, ETFE materials can be also chosen for the joint fittings.

Specifications

Item		Q / QI / QT				
Model		500	100	60	30	10
Maximum flow rate	mL/min	500	100	60	30	10
	L/h	30	6	3.6	1.8	0.6
	US G/h	7.92	1.58	0.95	0.47	0.15
Flow rate control range		5 to 500	Variable from 0.1 to the maximum flow rate (in 0.1mL/min steps*)			
Maximum discharge pressure	MPa	0.3	0.3	0.6	1.0	2.0
	bar	3	3	6	10	20
	psi	43.5	43.5	87	145	290
Stroke length	mm	1.8	1.3	0.9	0.5	
Transferable viscosity	mPa·s	50 or less	200 or less		100 or less	
Transferable temperature	°C	0 to 40 (no freezing)				
		0 to 60 for the Q/QI/QT-100-6T depending on the conditions (no freezing)*2				
Connection diameter		φ4 × φ6 (For Q-500 models, φ8 × φ10 on the suction side only)				
Environmental resistance		Corresponds to IP65 (dust proofing and waterproofing)*3				
Weight*4	kg	VE / VF: 1.6*5, TT: 1.7*6, 6T: 2.5*7				
Sound pressure level		Less than 70 dB				

^{*1} This can be changed in steps of 0.01 by using a parameter (manual operation mode only).

^{*2} Contact TACMINA for the conditions.

^{*3} Evaluated with the liquid end part installed.

^{*4} This is the weight of the Q (standard type). The weight of the stand is excluded.

^{*5} The Q/QI/QT-500 is 1.7 kg.

^{*6} This is the weight of the Q/QI/QT-100. The Q/QI/QT-500 is 1.9 kg. The weight of the Q/QI/QT-60 is 1.8 kg.

^{*7} This is the weight of the Q/QI/QT-100. The Q/QI/QT-500 is 2.7 kg. The Q/QI/QT-60/30 is 2.6 kg. The Q/QI/QT-10 is 2.9 kg.

●AC adapter supply

Power supply		Single phase, 100 to 240 VAC±10%, 47-63 Hz
Max. input current	A	0.7

●I/O signal specifications (QI and QT only)

Signal		QI	QT
Analog	Input	1 port 4 to 20mA DC Input resistance: Approximately 110Ω	—
Digital	Input	2 ports No-voltage contact or open collector (NPN) Maximum pulse count: 6000pulses/min Minimum pulse width: 5msec (ON time) Assigned to one of the following: Pulse, pause/run, level, or MAX operation	2 ports No-voltage contact or open collector (NPN) Maximum pulse count: 6000pulses/min Minimum pulse width: 5msec (ON time) Assigned to one of the following: Start, pause/run, level, or MAX operation
	Output	2 ports Open collector output 25VDC, 10mA or less Assigned to one of the following: Unit pulse, alarm, or operation signal	2 ports Open collector output 25VDC, 10mA or less Assigned to one of the following: Unit pulse, end signal, alarm, or operation signal

^{*} Digital signals use sync logic (NPN). Please use a converter when connecting to a source logic (PNP) device.
(Example of recommended equipment: DEK-TR/INV-2964319 manufactured by Phoenix Contact GmbH & Co. KG)

Consumables list

The recommended replacement cycles are for cases where the pump is operated under constant conditions (room temperature and clean water).

These cycles change according to individual site conditions, so use the recommended replacement cycles as a guide for replacing consumables. Neglecting to replace consumables may cause defective discharge (injection) or malfunction.

IMPORTANT

- Replace consumables after 4,000 hours of operation or 1 year of use, whichever is first.
- The hose and tube durability varies greatly depending on factors such as the chemical used, temperature, pressure, and ultra-violet rays. Inspect the parts and replace any that have deteriorated. Even during the warranty period of this product, you will be charged for replacement parts.

Part name	Quantity	Recommended replacement interval
Diaphragm	2	4,000 hours or 1 year
Sheet valve	1	
Packing	1	
Protective sheet	1	When deterioration or damage is visible

NOTE

- A "parts kit" containing a package of consumables and a "pump head set" are available.

Name	Details
Parts kit	Diaphragm × 2, sheet valve × 1, packing × 1, protective sheet × 1
Pump head set	Diaphragm × 2, sheet valve × 1, packing × 1, pump head assembly, parallel pin × 2, protective sheet × 1

Setting flowchart

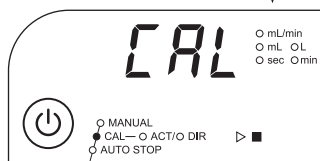
Mode switching

●Q (standard type)



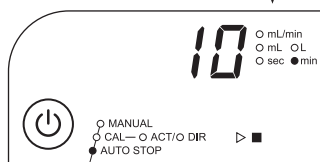
Manual operation mode
(page 33)

(MODE)



Calibration mode
(page 29)

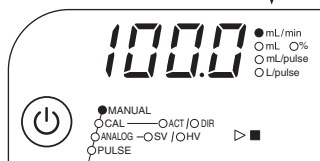
(MODE)



Auto-stop operation mode
(page 35)

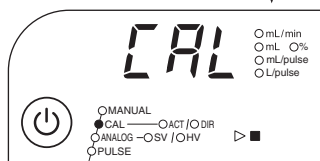
(MODE)

●QI (I/O signal control type)



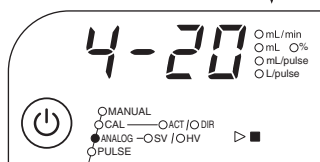
Manual operation mode
(page 33)

(MODE)



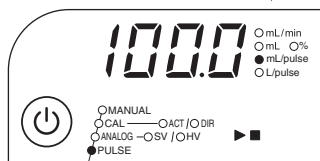
Calibration mode
(page 29)

(MODE)



Analog-input proportional
operation mode
(page 36)

(MODE)

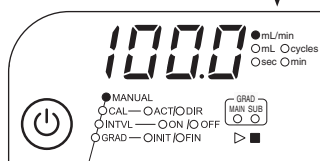


Pulse-input proportional
operation mode
(page 39)

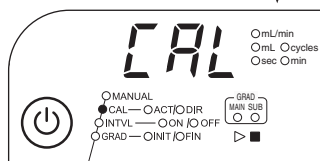
(MODE)

Setting flowchart

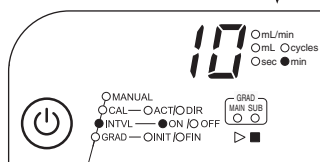
●QT (timer control type)



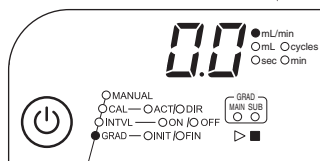
Manual operation mode
(page 33)



Calibration mode
(page 29)



Interval operation mode
(page 42)



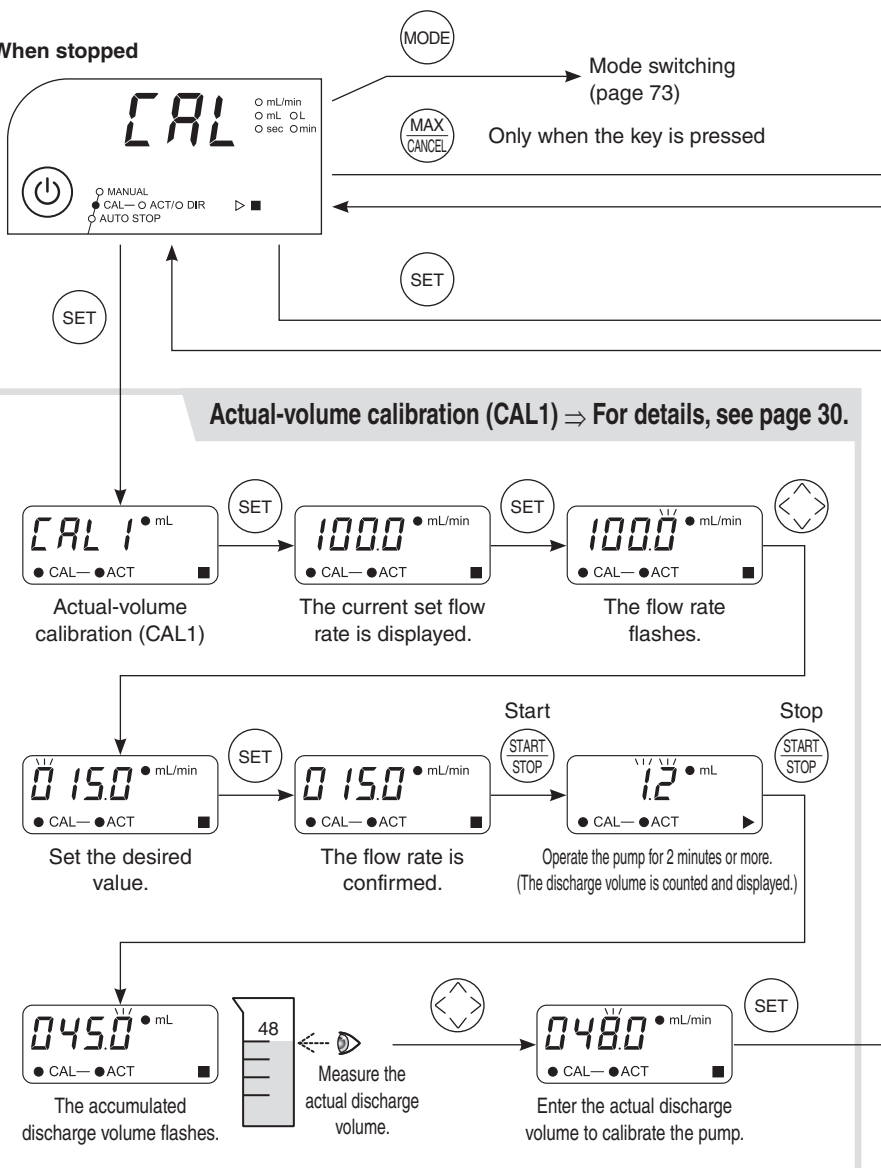
Gradient operation mode
(page 45)



Setting flowchart

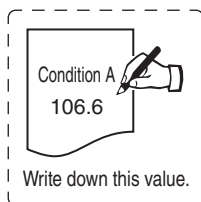
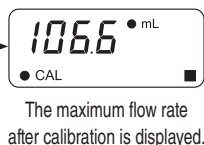
Calibration mode

When stopped



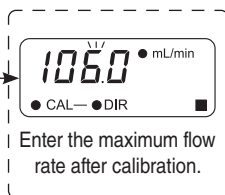
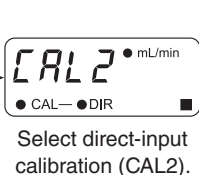
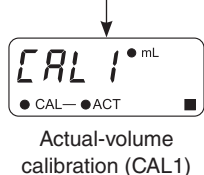
Setting flowchart

Displaying the maximum flow rate after calibration ⇒ For details, see page 32.



When using the pump again under the same condition

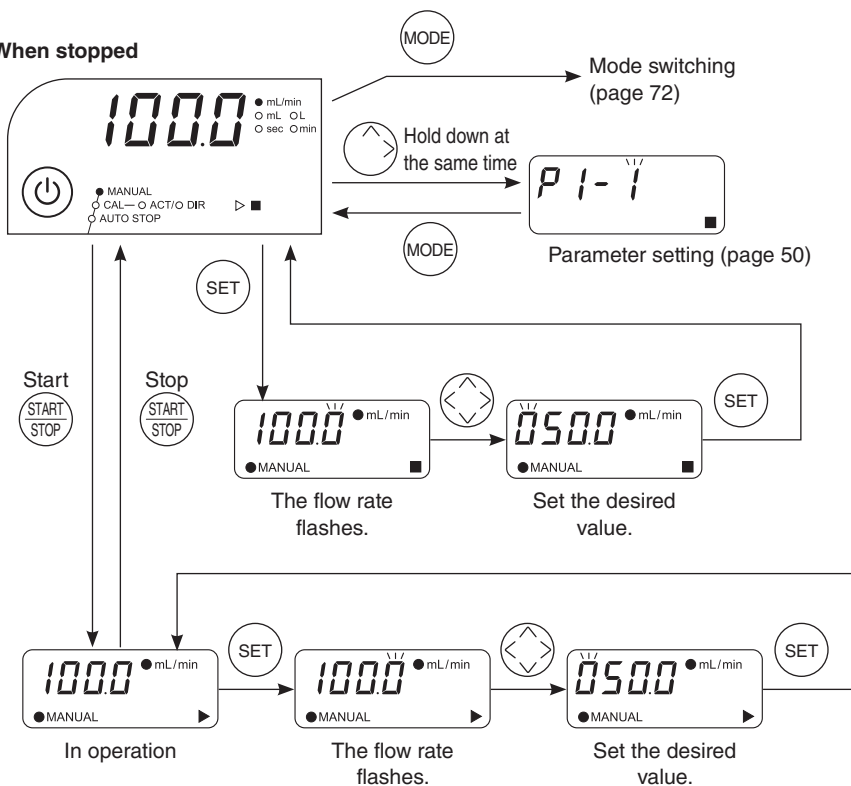
Direct-input calibration (CAL2) ⇒ For details, see page 32.



Setting flowchart

Manual operation mode

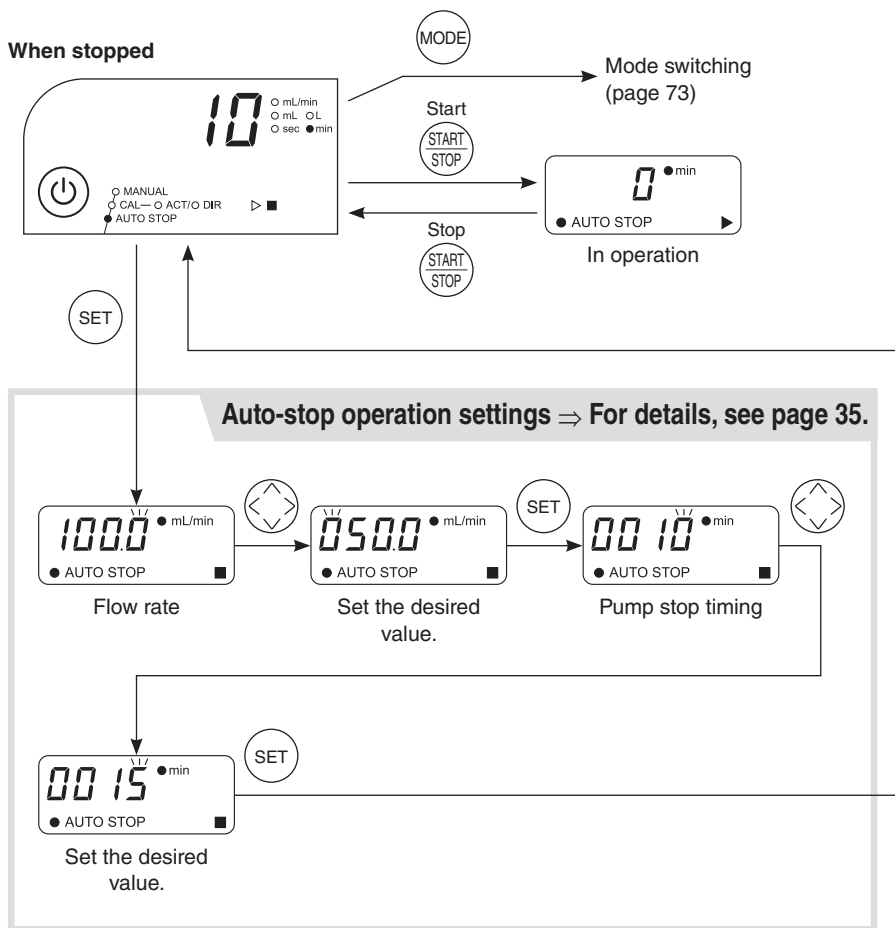
When stopped



Setting flowchart

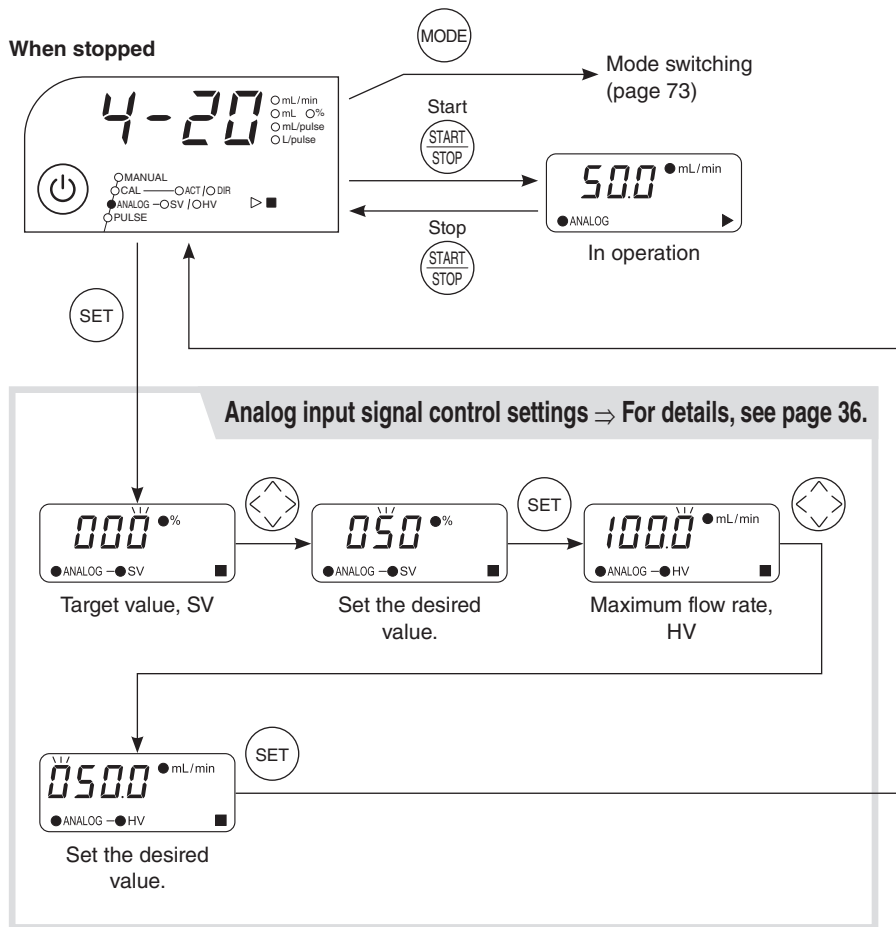
Auto-stop operation mode

When stopped



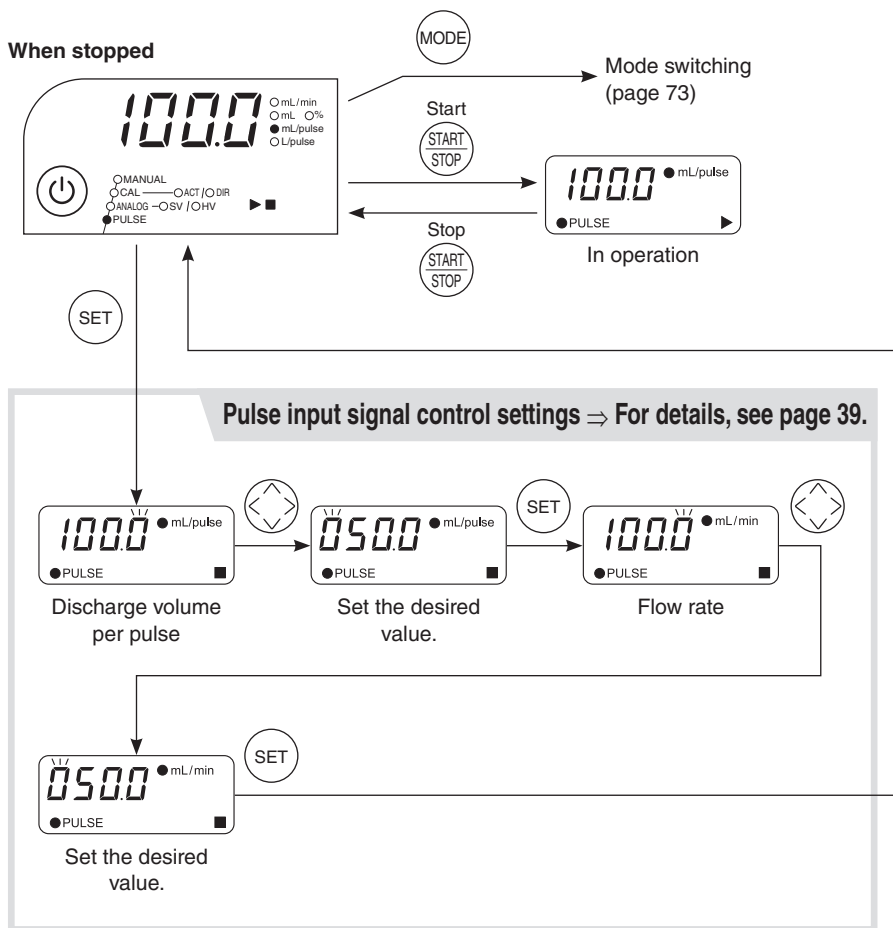
Setting flowchart

Analog-input proportional operation mode



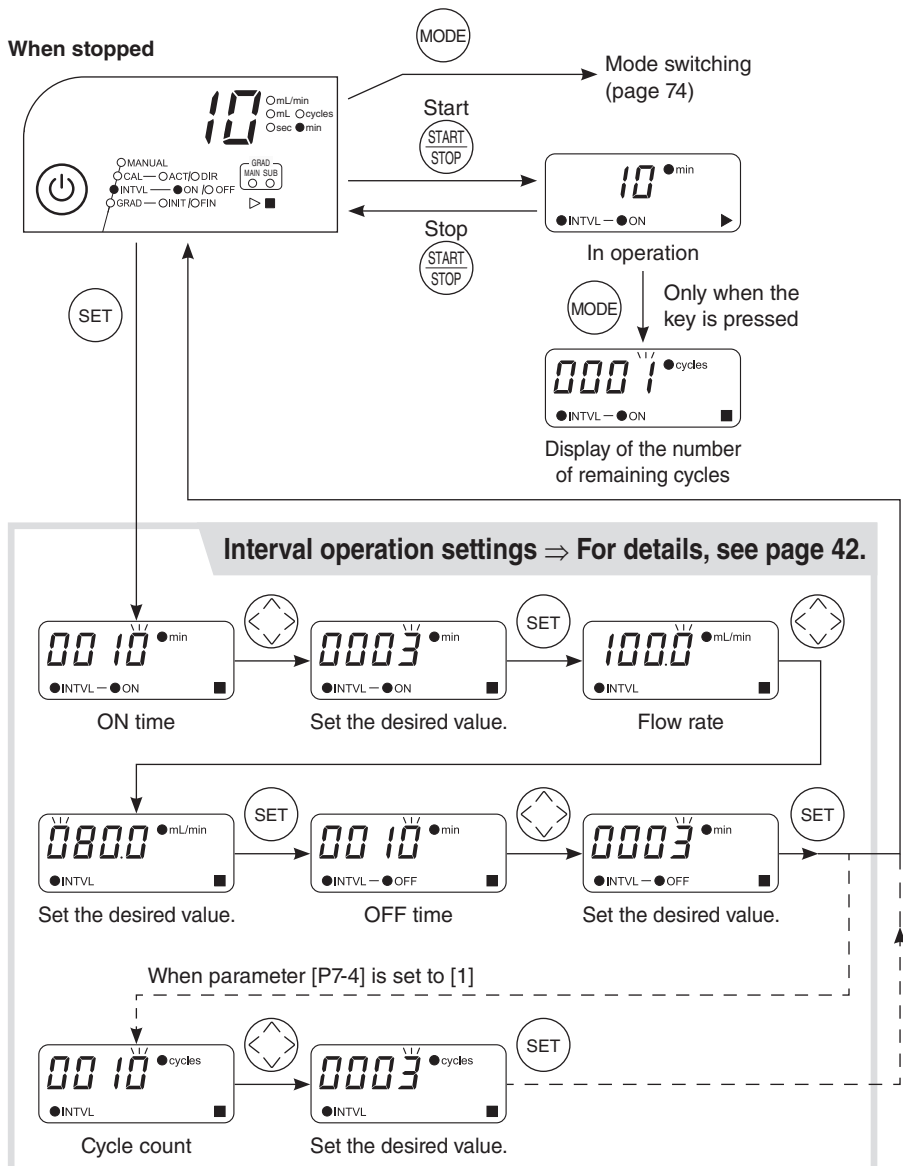
Setting flowchart

Pulse-input proportional operation mode



Setting flowchart

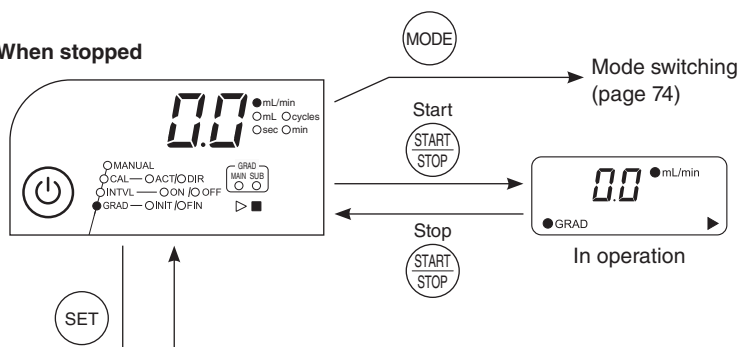
Interval operation mode



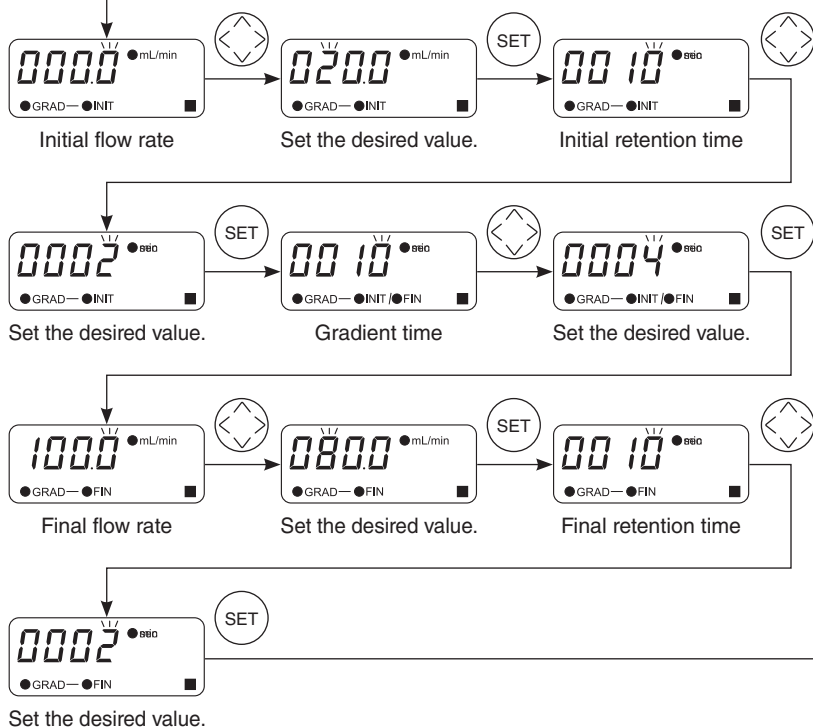
Setting flowchart

Gradient operation mode

When stopped



Gradient operation settings ⇒ For details, see page 45.



After-sales services

If any aspects of the terms and conditions of the after-sales service applying to the repairs to be provided during the warranty period and other such matters are not clear, consult your vender or a TACMINA representative.

Warranty

- (1) The warranty period shall be one year from the date of dispatch from TACMINA's factory.
- (2) If, during the warranty period, the product sustains malfunctions or damages as a result of design, manufacturing, or material defect, or if the product does not meet its specifications, TACMINA will arrange for repairs, provide replacement components, or replace the product, at TACMINA's discretion, at no charge to the customer. However, this warranty only covers direct damage to the product. Any consequential losses or damages, including, but not limited to, profit losses and any secondary damages, caused by malfunctions, breakage, or impaired performance of this product shall not be covered by this warranty. The limitation of TACMINA's liability shall not exceed the sales value of the defective product.
- (3) If a malfunction or damage is found, notice shall be given to distributor or TACMINA with documents that prove the malfunction or damage is caused by improper design, manufacturing failure or material defect within 14 days after awareness of such malfunction or damage. If the distributor or TACMINA does not receive such notice within aforementioned period, even though the warranty period is still in effect, TACMINA shall not be liable for any malfunction and damage. Please note that TACMINA may request to give further information or to return the product for investigation. If the cause is attributable to TACMINA's action, the shipping fees, cost of investigation and checks performed by TACMINA shall be borne by TACMINA.
- (4) Even in the warranty period, the cost of repairs in the following conditions shall be paid to the distributor or TACMINA.
 - 1) Damages and deterioration of consumables.
 - 2) Damages or malfunctions of the warranted product caused by carelessness in handling or incorrect use.
 - 3) Damages or malfunctions of the warranted product caused by the failure to perform maintenance such as periodic inspections and repairs and replacements of consumables.
 - 4) Damages or malfunctions of the warranted product caused by falls or impacts.
 - 5) Damages or malfunctions of the warranted product resulting from the use of parts other than the ones supplied by TACMINA.
 - 6) Damages or malfunctions of the warranted product resulting from product repairs or remodeling undertaken by individuals other than TACMINA employees or personnel of businesses authorized by TACMINA.

After-sales services

- 7) Damages or malfunctions of the warranted product resulting from fires, natural disasters, geological calamities, and force majeures.
 - 8) Damages or malfunctions of the warranted product resulting from loose bolts or nuts or from defective hose connections.
 - 9) Discoloration, deterioration, damages, or malfunctions of the warranted product resulting from ultraviolet rays, corrosive gases, or flooding.
 - 10) Damages or malfunctions of the warranted product resulting from corrosion, swelling, or melting caused by the adhesion or chemical effect of the used liquid.
 - 11) Damages or malfunctions of the warranted product resulting from damages to products other than those made by TACMINA.
 - 12) Damages or malfunctions of the warranted product resulting from usage outside of the range of the usage conditions listed in the operation manual.
- (5) The judgment of damages, malfunctions, and impaired performance as well as the judgment of whether the cause is the design of the product and product defects shall be performed by TACMINA's technical department.

Repairs

■Before requesting repairs

Please read this operation manual carefully and inspect the product again.

■Who to request repairs from

Ask your vendor to take care of the repairs. If you are not sure of who your vendor is, contact TACMINA.

■Precautions when sending the product for repairs

Be sure to observe the following items to protect worker safety and to protect the environment:

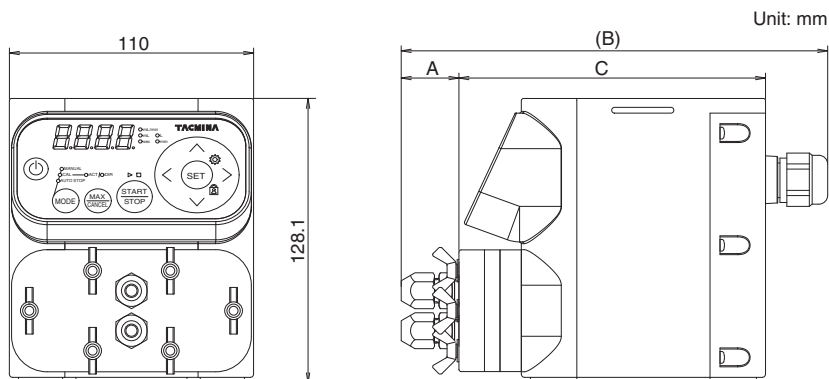
- If any chemicals have affixed to the product, wash it clean.
- Attach the safety data sheet (SDS) to the product.
- If a "maintenance data" page is present at the end of the operation manual, fill in this page and attach it to the product.
- * The product may not be repaired if the necessary materials are not attached.
- * Even when the necessary materials are attached, TACMINA may send the product back if it is determined that repairing the product will constitute risks or dangers.

■Minimum retention period for consumables

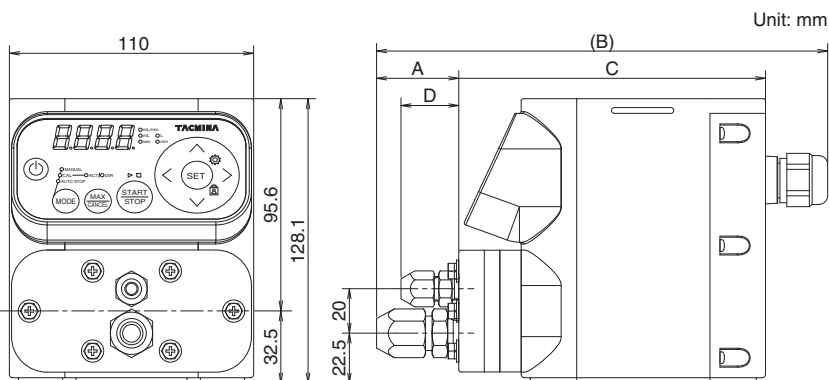
TACMINA will continue to supply consumables for its pumps for a period of eight (8) years after the manufacture of the pumps has been discontinued.

External Dimensions

* The example given here is of the standard model. For information on the separate models, see the diagrams.



	Q-100				Q-60		Q-30	Q-10
	VE	VF	TT	6T	TT	6T	6T	6T
A	26			22	26	22	22	22
B	194			190	194	190	187	193
C	138.1		137.6		137.6	137.6	135.1	140.6



	Q-500			
	VE	VF	TT	6T
A	37	37	33	27.5
B	203	203	199	193
C	138.1	138.1	137.6	137.7
D	26	26	26	22

EU DECLARATION OF CONFORMITY

(Directive 2006/42/EC, 2014/35/EU, 2014/30/EU, 2011/65/EU - Annex II A)

Manufacturer : TACMINA CORPORATION

Address : 2-2-14, Awajimachi, Chuo-ku, Osaka, 541-0047, Japan

Herewith declares that

Product : Pulseless Motor-Driven Diaphragm Metering Pump

Model (Type) : Q Series (See Appendix 2-4)

- is in conformity with the provisions of Machinery Directive 2006/42/EC,
- is in conformity with the provisions of Low Voltage Directive 2014/35/EU,
- is in conformity with the provisions of EMC Directive 2014/30/EU.
- and, is in conformity with the provisions of Restriction of the use of certain hazardous substances Directive 2011/65/EU.

And furthermore declares that

- the following (parts / clauses of) harmonized standards have been applied :

Machinery Directive

EN809, EN12100

Low Voltage Directive

EN61010-1, EN60529

EMC Directive

EN55011, EN61000-3-2/3, EN61000-6-2, EN61000-4-2/3/4/5/6/8/11

RoHS Directive

IEC 63000:2018

Date: 27. Oct. 2025

Tadashi Kukitome

Name : Tadashi Kukitome

Position : Head of Development Center

TACMINA CORPORATION

Product designs and specifications are subject to change without notice for product improvement.

TACMINA CORPORATION

Head Office:

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